Circular No. 849

Cutworms, Armyworms and Related Species Attacking Cereal and Forage Crops in the Central Great Plains

By

H. H. WALKDEN

Division of Cereal and Forage Insect Investigations

Bureau of Entomology and Plant Quarantine

Agricultural Research Administration

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Washington 25, D. C. - Price 20 cents

UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C. OCTOBER 1950

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By H. H. Walkden

Entomologist, Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration[1]

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INTRODUCTION

Cutworms and armyworms [2] have at times caused widespread damage to cereal and forage crops in the central Great Plains. Wheat, alfalfa, sorghum, corn, oats, and barley are basic crops in this region, which includes the western parts of Nebraska and Kansas, northwestern Oklahoma, the Texas Panhandle, northeastern New Mexico, and eastern Colorado. More than one-third of the region is in permanent pasture, and the forage value of the grasses growing in these pastures and range lands is great. The planting of large tracts to a single crop has provided an abundance of food plants on which many native insects have developed into pests of major importance.

Cutworms are the larvae of certain Phalaenidae that at night eat or cut off young plants. Some species feed chiefly underground; others are surface feeders; still others climb into trees and shrubs to feed on the buds and foliage. Under certain conditions cutworms

[1] These investigations were conducted under the supervision of R. T. Cotton and J. R. Horton.

[2] Order Lepidoptera, family Phalaenidae (formerly Noctuidae).

assume the army habit and move in large numbers along a more or less definite line of march in search of food; then they are called armyworms. They are not gregarious, however.

An investigation of the bionomics of this group of insects in relation to cereal and forage crops in the central Great Plains was conducted in Kansas. Sufficient supplementary observations were made in the neighboring States to establish the applicability of the results.

Information on the less important species of Phalaenidae, or owlet moths, was also obtained. An extensive owlet moth fauna is present in this region. During these investigations the larvae of 54 species were observed in cereal and forage crops, pasture grasses, and wastelands.[3] The following species are known to be of major economic importance: Pale western cutworm (*Agrotis orthogonia* Morr.); army cutworm (*Chorizagrotis auxiliaris* (Grote)); variegated cutworm (*Peridroma margaritosa* (Haw.)); armyworm (*Cirphis unipuncta* (Haw.)); fall armyworm (*Laphygma frugiperda* (A. and S.)); corn earworm (*Heliothis armigera* (Hbn.)).

Twenty-three additional species are of local or minor importance. The remaining species were not known previously to be injurious to cereal and forage crops. The species attacking these crops fall into the following groups, based on the feeding habits of the larvae:

Subterranean cutworms.—Species that feed almost exclusively beneath the surface of the soil.

Tunnel makers.—Species that make tunnels opening at the surface of the soil, and, after cutting off portions of the host plant, drag their food into the tunnel and consume it there.

Surface feeders.—Species that feed at or near the surface of the soil.

Climbers.—Species that have developed the habit of climbing the host plants and feeding on the stems, buds, foliage, flowers, or seeds.

Borers.—Species that bore into the stems or crowns of the host plants and feed in the channels therein.

FACTORS INFLUENCING DISTRIBUTION AND ABUNDANCE

The Phalaenidae discussed in this circular fall into two main groups according to their moisture requirements. Cook (*4*, pp. 36–37) [4] pointed out that the distribution and abundance of the various species and also the activities of their natural enemies are limited by the moisture content of the soil and the seasonal sequence of this and other ecological factors.

Inasmuch as a portion of the central Great Plains lies within the transition zone from semiarid to arid conditions, climatic fluctuations would be expected to cause variations in the destructive range of the phalaenid species inhabiting it. Thus, after a period of dry years an eastward extension of the normal range of the pale western cutworm was noted. The outbreak of this cutworm in western Kansas, which began in 1936 and continued until 1941, was associated with the prev-

[3] The determinations of the various species of cutworms and their natural enemies were made by specialists in the Division of Insect Identification, Bureau of Entomology and Plant Quarantine, or by the writer by comparison with specimens so determined.

[4] Italic numbers in parentheses refer to Literature Cited, p. 49.

alence of dry seasons during that period. Conversely, excessive soil moisture favors the increase of *Agrotis ypsilon*, and this species, usually scarce in Kansas, appeared in destructive abundance after the floods of 1935. This species tolerates more moisture than any of the others observed, and it can develop in saturated soil.[5]

Many species in this region are at the outward limits of their normal range of destructive abundance. Thus, the pale western cutworm is near the eastward limit, the variegated cutworm at the westward limit, and the fall armyworm at the northern limit of its range. The fall armyworm is actually beyond its range of complete development, since, so far as is known, it is unable to pass the winter in the central Great Plains, but invades this region annually from infestations originating farther south.

Crumb (*5*) points out that the metropolis of most multiple-brooded species is in the warmer latitudes, owing largely to their low resistance to cold and their tendency to hibernate as pupae; that single-brooded species tend to be of northern distribution but, as they advance southward, higher average temperatures shorten the cycle of development; and that in order to make the life cycle occupy a full year, a quiescent period, which becomes more prolonged as a species advances southward, is interpolated. Thus, with the pale western cutworm in Kansas, development is retarded in the larval stage and the summer is passed in a quiescent state within the pupal cell. The army cutworm estivates in the adult stage. Other species having a period of retarded development include *Agrotis gladiaria*, *A. venerabilis*, and *Feltia subgothica* in the larval stage, and *Anicla badinodis* and *Orthodes incincta* in the pupal stage.

Powerful repressive factors must be operating to limit the abundance of most species. During 1934–37 nearly 300 species of Phalaenidae were taken in light traps operated at several places in Kansas and Nebraska (Walkden and Whelan (*21*)). Many were of the cutworm type. It is noteworthy, therefore, that so few species have developed into major economic pests.

KEY TO LARVAE OF SOME SPECIES OF PHALAENIDAE

Many species of cutworms resemble each other so closely that structural characters (figs. 1–7) for distinguishing them are difficult to find. To facilitate identification of the cutworms and armyworms likely to be encountered in the central Great Plains, the writer has prepared a key to the larvae for use in separating the species taken in the many collections made during this investigation. It is based on existing keys, but includes additional species taken in the region and the months in which some of them were found. The arrangement and size of the setigerous tubercles on the abdominal segments of the larvae are useful characters for separating the species. A diagram of the arrangement and numbering of the setae of a typical cutworm larva is shown in figure 3. The setae and markings of the head are

[5] MANNIS, H. J. MOISTURE TOLERANCE OF THE BLACK CUTWORM. 1937. [Unpublished master's thesis, copy on file at Kans. State Col. Agr., Manhattan.]

also useful. The head markings of several of the more common species are illustrated in figure 7. The key follows.

1. Adfrontal sutures terminating in occipital foramen (fig. 1, *A*). Skin granulose (fig. 2, *A–F*, *L–N*). (In some specimens of *Peridroma margaritosa* (Haw.) sutures nearly reach occipital foramen, but the smooth skin places it in the next category) 2
   Adfrontal sutures not reaching occipital foramen (fig. 1, *B*). Skin granulose or smooth 10
2. Head more or less fuscous—or ferruginous reticulate (fig. 1, *C*) or reticulation absent 4
   Reticulation of head shield entirely replaced by fuscous freckles (fig. 1, *D*) 3
3. Setigerous tubercle II of the abdominal segments about 3 times as large as tubercle I (fig. 3). Claws of legs with a distinct tooth at base (fig. 4, *A*). March ..... *Chorizagrotis auxiliaris* (Grote)
   Setigerous tubercle II of abdominal segments about the same size as tubercle I. Claws of the legs with base broadly rounded (fig. 4, *B*). April ..... *Agrotis vetusta* (Wlk.)
4. Reticulation of head absent, fuscous coloring limited to submedian arcs (fig. 1, *E*). April–May ..... *Agrotis orthogonia* Morr.
   Head distinctly reticulate. Fuscous coloring not limited to submedian arcs (fig. 1, *C*) 5
5. Skin granules very small, flat, or slightly convex, set contiguously, like blocks in a pavement, without secondary granules (fig. 2, *A*, *C*) 6
   Skin granules coarse, strongly convex, or conical, interspersed irregularly with smaller secondary granules (fig. 2, *B*, *D*, *E*) 8
6. Tubercle I of abdominal segments nearly, or quite as large as tubercle II ..... *Agrotis malefida* Guen.
   Tubercle I of abdominal segments distinctly smaller than tubercle II 7
7. Dorsum dark gray. Basal portion of claw distinctly acutely angulate (fig. 4, *E*). March–April ..... *Agrotis venerabilis* Wlk.
   Dorsum tinged with ferruginous. Basal portion of claw broadly rounded, but slightly angulate (fig. 4, *F*). March–April ..... *Agrotis gladiaria* (Morr.)
8. Skin granules strongly convex, coarse, interspersed irregularly with smaller secondary granules (fig. 2, *B*, *D*) 9
   Skin granules upright, conical, somewhat retrorse (fig. 2, *E*). September ..... *Feltia subterranea* (F.)
9. Tubercle I of abdominal segments nearly or quite as large as tubercle II. Fuscous coloration of supraspiracular area strongly intensified subdorsally on anterior half of each segment. March–April ..... *Feltia subgothica* (Haw.)
   Tubercle I of abdominal segments distinctly smaller than tubercle II. Fuscous coloration of supraspiracular area not intensified as above May–June ..... *Agrotis ypsilon* (Rott.)
10. Skin granulose or spinose 11
    Skin smooth 16
11. Skin spinose, or, if granulose, granules conical or coarse and isolated, closely set but not contiguous (fig. 2, *F*, *G*) 12
    Skin granules small, flat, or slightly convex, set contiguously like blocks in a pavement (fig. 2, *H*, *J*, *K*) 13
12. Skin granules roundingly conical (fig. 2, *F*). Head coarsely granulose. April ..... *Lacinipolia renigera* (Steph.)
    Skin granules sharp-pointed, spinelike, interspersed with smaller sharp-pointed granules (fig. 2, *G*). Head smooth, shining. June–September ..... *Heliothis armigera* (Hbn.)
13. Each mandible with 4 or 5 distinct teeth. Body not prominently striped 14
    Each mandible with only 2 teeth, anteriorly. Body prominently striped. April ..... *Nephelodes emmedonia* (Cram.)
14. Claws of legs acutely angulate at base (fig. 4, *M*). Dorsal markings not rhomboidal ..... *Laphygma frugiperda* (A. and S.)
    Claws of legs with base broadly rounded (Fig. 4, *L*, *N*). A segmental series of rhomboidal infuscated markings on dorsum 15

15. Setigerous tubercles of abdominal segments conspicuous, large, fuscous. Seta IV set in upper edge of tubercle. Tubercle V very large, much larger than tubercle IV (fig. 5, *A*). March ..... *Orthodes incincta* (Morr.)
Setigerous tubercles of abdominal segments small. Seta IV set in center of tubercle. Tubercle V normal and about the same size as tubercle IV. March ..... *Lacinipolia meditata* (Grote)
16. Each mandible with 4 or 5 distinct teeth 17
Each mandible with but 3 distinct teeth, 2 obscure teeth, or about 12 small teeth, or toothless 26
17. Line joining setae III and V on seventh abdominal segment passing distinctly anterior to spiracle (fig. 5, *B*). June ..... *Protoleucania albilinea* (Hbn.)
Line joining setae III and V on seventh abdominal segment passing through, or posterior to spiracle (fig. 5, *C*, *D*) 18
18. Seta O_1 on or anterior to a line connecting centers of ocelli IV and VI (fig. 6, *A*) 19
Seta O_1 posterior to a line connecting centers of ocelli IV and VI (fig. 6, *B*) 20
19. Reticulation of head dark. Adfrontal areas not white. August–September ..... *Laphygma exigua* (Hbn.)
Forepart of head deep fuscous or black. Reticulation obsolete on forepart of head. Obscure reticulation laterally. Adfrontal area conspicuous white (fig. 1, *F*). June–July ..... *Prodenia ornithogalli* Guen.
20. Spiracles entirely black, or with central area dark brown 21
Spiracles with dark rims, central area pale, or light brown 23
21. Dorsum with a segmental series of definite markings. Reticulation of head fuscous or ferruginous, or fuscous coloring limited to submedian arcs, and ocellar region 22
Dorsum with no markings except pale median line. No reticulation on head. Fuscous coloring limited to a lateral stripe passing through ocelli. May–July ..... *Papaipema nebris* (Guen.)
22. Subdorsal black markings linear. Distinct middorsal yellow spot on each abdominal segment, at least anteriorly. May–June.
Peridroma margaritosa (Haw.)
Subdorsal black markings wedge-shaped. April ..... *Anicla badinodis* (Grote)
Dorsal area of abdomen bearing a series of shield-shaped, deeply infuscated brown spots, with their apices directed posteriorly. April.
Rusina bicolorago (Guen.)
23. With distinct black spots above spiracles. April.
Spaelotis clandestina (Harr.)
No distinct black spots above spiracles 24
24. With wedge-shaped subdorsal black spots, at least posteriorly. April.
Amathes c-nigrum (L.)
No subdorsal black spots 25
25. Claws of legs with base broadly rounded (fig. 4, *V*). A distinct pale subspiracular stripe ..... *Dipterygia scabriuscula* (L.)
Claws of legs with base acutely angulate (fig. 4, *W*). No distinct subspiracular stripe ..... *Septis cariosa* (Guen.)
26. Spiracles entirely black. May–June, September ..... *Cirphis unipuncta* (Haw.)
Spiracles pale with dark rims 27
27. With a dark longitudinal stripe on abdomen through setigerous tubercle II. March–April ..... *Leucania phragmatidicola* (Guen.)
No dark longitudinal stripe on abdomen through setigerous tubercle II 28
28. Mandible with 3 distinct teeth 29
Mandibles with cutting margin straight and toothless, or bearing about 12 small teeth ..... *Anicla infecta* (Ochs.)
29. Prolegs on fourth, fifth, sixth, and anal segments. September.
Plathypena scabra (F.)
Prolegs on fifth, sixth, and anal segments. September.
Caenurgina erechtea (Cram.)

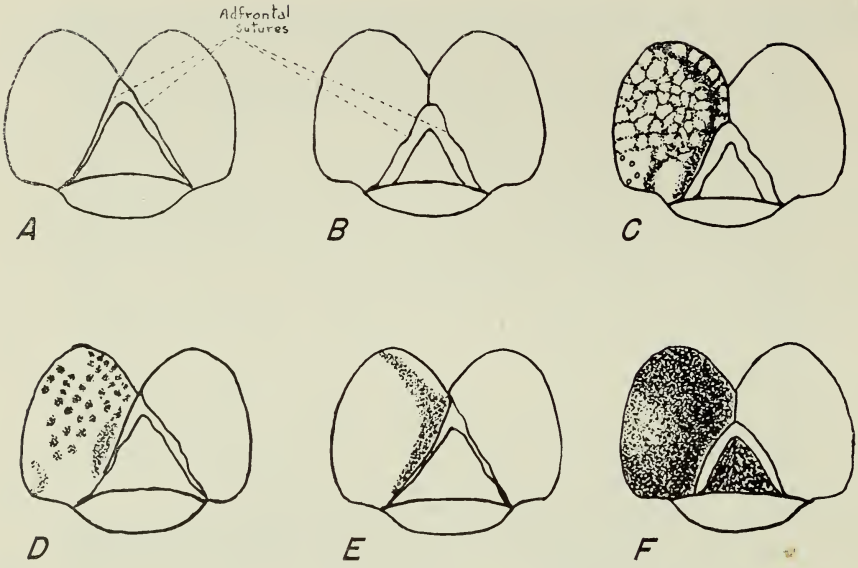

FIGURE 1.—HEAD CHARACTERS OF CUTWORMS

A, Head capsule with adfrontal sutures terminating in the occipital foramen.
B, Head capsule with adfrontal sutures not reaching the occipital foramen.
C, Type of fuscous reticulation on head capsule.
D, Head with reticulation replaced by fuscous freckles.
E, Head with fuscous coloration limited to submedian arcs.
F, Head with deep fuscous coloration, and adfrontal areas conspicuous white.

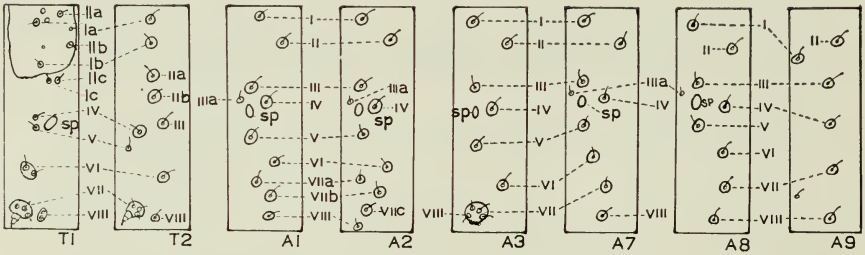

FIGURE 3.—ARRANGEMENT AND NUMBERING OF SETAE ON TYPICAL CUTWORM LARVA: Thoracic segments, *T1* and *T2*; abdominal segments, *A1*, *A2*, *A3*, *A7*, *A8*, *A9*; spiracle, *sp*.

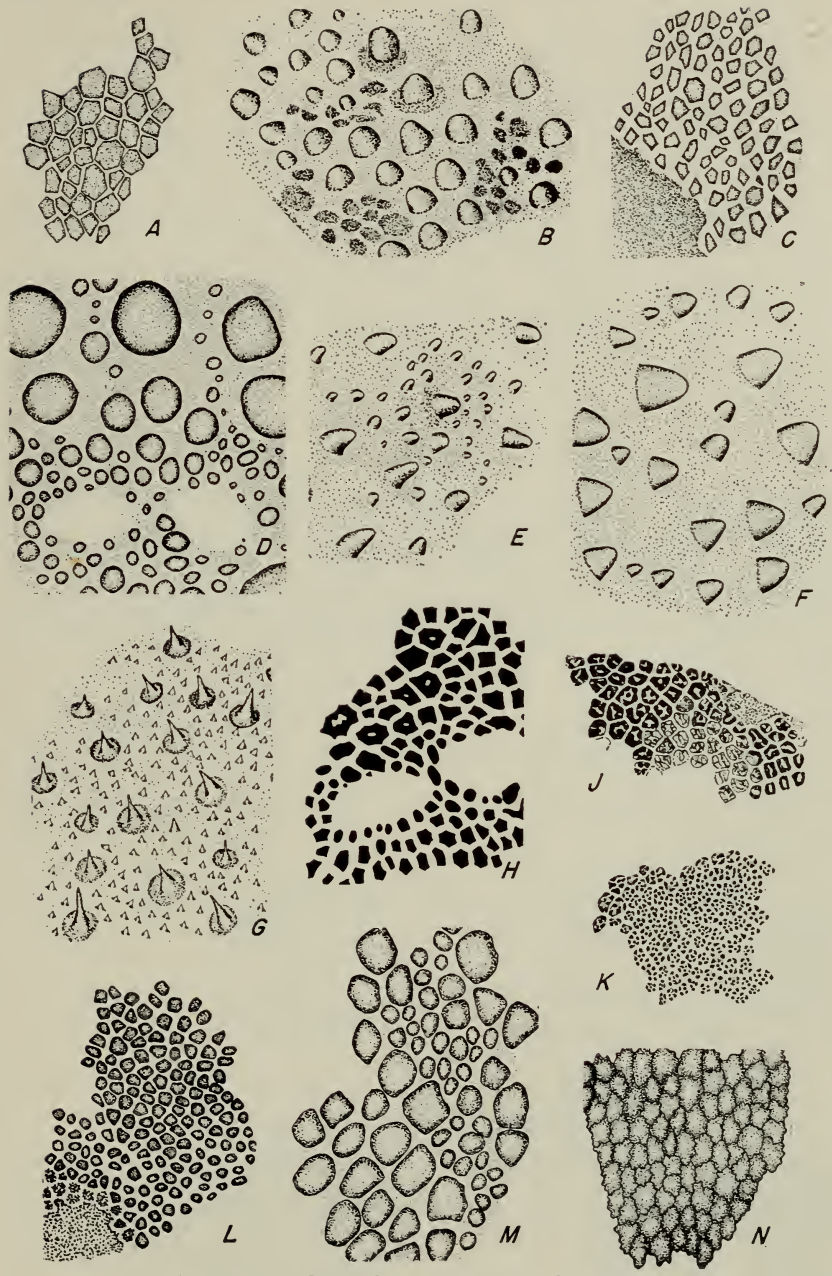

FIGURE 2.—SKIN CHARACTERS OF CUTWORMS

A, *Agrotis gladiaria* (Morr.).
B, *Feltia subgothica* (Haw.).
C, *Agrotis venerabilis* Wlk.
D, *Agrotis ypsilon* (Rott.).
E, *Feltia subterranea* (F.).
F, *Lacinipolia renigera* (Steph.).
G, *Heliothis armigera* (Hbn.).
H, *Nephelodes emmedonia*, (Cram.).
J, *Lacinipolia meditata* (Grote).
K, *Orthodes incincta* (Morr.).
L, *Chorizagrotis auxiliaris* (Grote).
M, *Agrotis orthogonia* Morr.
N, *Agrotis vetusta* (Wlk.).

FIGURE 4.—TARSAL CLAWS OF CUTWORMS

A, *Chorizagrotis auxiliaris* (Grote).
B, *Agrotis vetusta* (Wlk.).
C, *Agrotis orthogonia* Morr.
D, *Feltia subgothica* (Haw.).
E, *Agrotis venerabilis* Wlk.
F, *Agrotis gladiaria* (Morr.).
G, *Feltia subterranea* (F.).
H, *Agrotis ypsilon* (Rott.).
I, *Lacinipolia renigera* (Steph.).
J, *Heliothis armigera* (Hbn.).
K, *Nephelodes emmedonia* (Cram.).
L, *Lacinipolia meditata* (Grote).
M, *Laphygma frugiperda* (A. and S.).
N, *Orthodes incincta* (Morr.).
O, *Protoleucania albilinea* (Hbn.).
P, *Laphygma exigua* (Hbn.).
Q, *Prodenia ornithogalli* Guen.
R, *Papaipema nebris* (Guen.).
S, *Peridroma margaritosa* (Haw.).
T, *Anicla badinodis* (Grote).
U, *Amathes c-nigrum* (L.).
V, *Dipterygia scabriuscula* (L.).
W, *Septis cariosa* (Guen.).
X, *Cirphis unipuncta* (Haw.).
Y, *Leucania phragmatidicola* Guen.
Z, *Anicla infecta* (Ochs.).
AA, *Plathypena scabra* (F.).
BB, *Caenurgina erechtea (Cram.)*

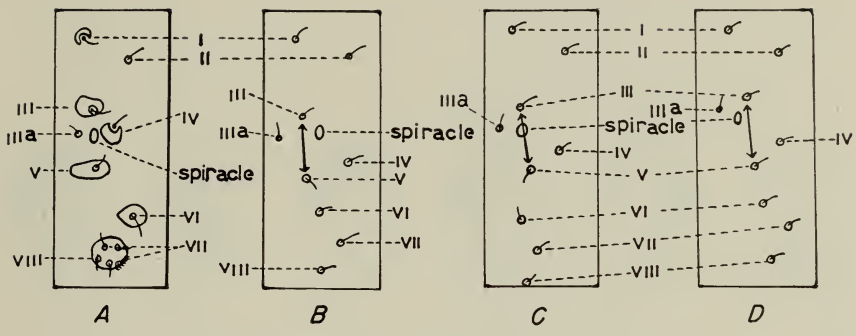

FIGURE 5.—BODY SETAE OF CUTWORMS

A, Orthodes incincta, third abdominal segment showing seta IV set in upper edge of tubercle, and large size of tubercle V.

B, Protoleucania albilinea, seventh abdominal segment showing line joining setae III and V passing anterior to the spiracle.

C, Peridroma margaritosa, seventh abdominal segment showing line joining setae III and V passing through the spiracle.

D, Anicla badinodis, seventh abdominal segment showing line joining setae III and V passing posterior to the spiracle.

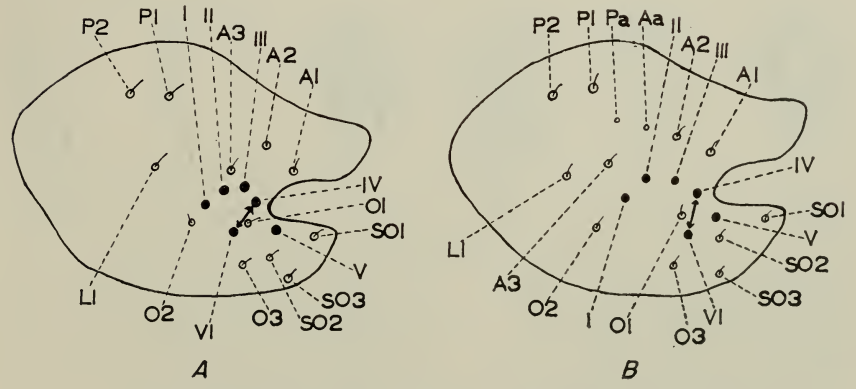

FIGURE 6.—HEAD CHARACTERS OF CUTWORMS, SIDE VIEW

A, Prodenia ornithogalli showing seta O_1 anterior to a line connecting the centers of ocelli IV and VI.

B, Papaipema nebris showing seta O_1 posterior to a line connecting the centers of ocelli IV and VI.

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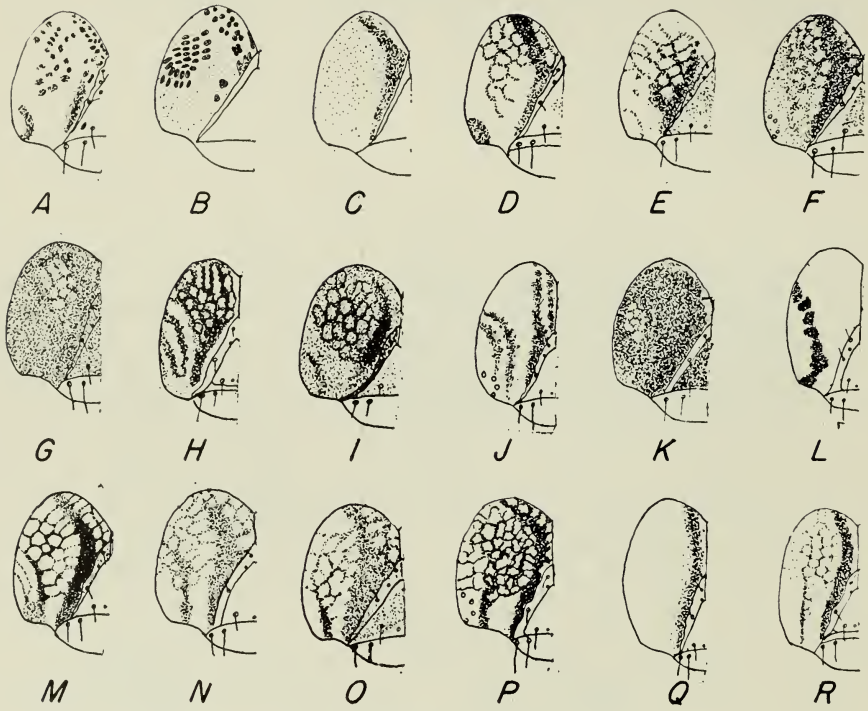

FIGURE 7.—HEAD CHARACTERS OF CUTWORMS, FRONT VIEW

A, *Chorizagrotis auxiliaris* (Grote).
B, *Agrotis vetusta* (Wlk.).
C, *Agrotis orthogonia* Morr.
D, *Agrotis gladiaria* (Morr.).
E, *Feltia subterranea* (F.).
F, *Agrotis ypsilon* (Rott.).
G, *Lacinipolia meditata* (Grote).
H, *Laphygma frugiperda* (A. and S.).
I, *Orthodes incincta* (Morr.).
J, *Protoleucania albilinea* (Hbn.).
K, *Prodenia ornithogalli* Guen.
L, *Papaipema nebris* (Guen.).
M, *Peridroma margaritosa* (Haw.).
N, *Anicla badinodis* (Grote).
O, *Amathes c-nigrum* (L.).
P, *Cirphis unipuncta* (Haw.).
Q, *Leucania phragmatidicola* Guen.
R, *Anicla infecta* (Ochs.).

In addition to the species of which larvae were taken, adults of the following species were taken in light traps:

Euxoa—
siccata (Sm.)
brevipennis brevistriga (Sm.)
sicatricosa (G. and R.)
quadridentata (G. and R.)
atristrigata(Sm.)
catenula (Grote)
mitis ura (Sm.)
aurulenta f. *aurulentiodes* (Strand)
intrita (Morr.)
immixta (Grote)
medialis poncha (Sm.)
placida B. and McD.
mimallonis (Grote)
recticincta (Sm.)
remota (Sm.)
simona McD.
declarata (Wlk.)
verticalis (Grote)
albipennis (Grote)
obeliscoides (Guen.)
Euxoa—Continued
costata idahoensis (Grote)
clausa McD.
tristicula (Morr.)
Chorizagrotis thanatologia (Dyar)
Loxagrotis albicosta (Sm.)
Onychagrotis rileyana (Morr.)
Agrotis—
daedalus (Sm.)
volubilis Harv.
Spaelotis havilae (Grote)
Hemieuxoa rudens (Harv.)
Abagrotis barnesi (Benj.)
Protoleucania rubripennis (G. and R.)
Lithophane—
georgii (Grote)
unimoda (Lint.)
Septis—
relicina (Morr.)
arctica (Freyer)
Crymodes devastator (Brace)
Heliothis virescens (F.)

SUBTERRANEAN CUTWORMS

Cutworms of the subterranean group feed almost exclusively under the surface of the soil, and therefore are controllable only by cultural or preventive methods.

Agrotis orthogonia Morrison

Pale Western Cutworm

(Figs. 2, *M*; 4, *C*; 7, *C*)

Distribution.—This species is a typical dry-land cutworm. It is confined to the semiarid and arid sections of the United States. Outbreaks have occurred in western Kansas, northeastern New Mexico, the Panhandle sections of Texas and Oklahoma, eastern Colorado, western South Dakota and North Dakota, Montana, Utah, and Wyoming in the United States, and in Saskatchewan, Canada. The most easterly point of occurrence in the central Great Plains is about 12 miles east of La Crosse, Kans. Although the species was first described by Morrison in 1876 from Glencoe, now a "ghost" town, in northeastern Nebraska, only one small infestation was discovered in that State during the investigations on cutworms. This infestation was at Chadron, nearly 400 miles west of the site of Glencoe. No other collection of the species in Nebraska is recorded.

Economic status.—This species is of major economic importance in the semiarid region of the Great Plains, particularly after a series of dry years.

Crops attacked and character of injury.—In the central Great Plains, winter wheat and spring barley are the favored host plants of the pale western cutworm, although there have been minor losses in newly seeded alfalfa. The larvae feed almost entirely underground, and sever the plants just above the crown, causing them to wilt and die.

The larvae begin to feed soon after the wheat has begun to turn green in the spring. In outbreak years bare spots appear, usually on knolls with southern exposure, and severe infestations soon involve entire fields. From a distance these bare spots have the appearance of drought injury. In spring barley, particularly that sown in wheat-stubble ground, the attack reaches its greatest intensity about the time the plants have developed two or three leaves. Entire fields may be completely destroyed in a very short time.

Seasonal history.—The pale western cutworm has only a single generation annually. The eggs are deposited in the soil late in September or early in October. The larvae develop within the eggs, but do not hatch until the following March. For a time the young larvae feed above ground, skeletonizing the leaves of wheat or other host plants, but after the first instar they assume the subterranean habit. During the rest of their development the larvae remain below ground unless forced to the surface by excessive moisture. They mature late in April or early in May and descend 3 to 5 inches in the soil, depending on the depth of the plow sole or hardpan. Here they form earthen cells and remain quiescent until late in July or early in August, when they begin to pupate. The adults emerge during the latter part of September and deposit eggs soon thereafter.

Natural enemies.—As might be expected, because of the subterranean habit of this species, only slight parasitization was noted. During 1936–40 large numbers of larvae were collected in infested fields and reared individually to determine the degree and kind of parasitization and disease. The results are summarized in table 1.

TABLE 1.—*Mortalities of larvae of Agrotis orthogonia caused by various natural enemies, 1936–40*

Year	Larvae observed	Larvae killed by—				Total mortality
		Hymenoptera	Diptera	Nematoda	Disease	
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1936	322	6	5	2	41	51
1937	788	.3	1	----	10	11
1938	467	3	.2	.2	28	31
1939	475	1	6	----	10	18
1940	596	1	2	----	5	8

Many parasites could be determined only to the order because of the difficulty of inducing the adults to emerge. The following parasites and disease organisms were reared from field-collected larvae:

Hymenoptera—*Meteorus vulgaris* (Cress.), *Netelia ocellata* (Vier.), *Apanteles griffini* Vier.

Diptera—*Neophorocera claripennis* (Macq.), *Phosococephalops texensis* (Reinhard), *Salmacia sequax* (Will.), Bombyliidae (species unknown), Tachinidae (species unknown).

Disease organisms—Undetermined wilt, *Metarrhizium anisopliae* (Metsch), *Beauvaria* sp., *Isaria* sp., *Sorosporella uvella* (Krass).

Many larvae collected in the field for rearing in the laboratory died of a disease that turned them black. This was termed "rearing disease." Dead larvae having somewhat the same appearance were noted in the field after heavy rains.

TUNNEL-MAKING CUTWORMS

Four species of cutworms have the habit of making tunnels in the moist soil near their host plants, where they hide during the day. At night they come out, cut off pieces of the foliage of their host plants, and take this food into their tunnels.

Agrotis gladiaria (Morrison)

(Figs. 2, *A*; 4, *F*; 7, *D*)

Distribution.—This species is generally distributed in the United States and Canada east of the Rocky Mountains.

Economic status.—In the central Great Plains this cutworm occasionally becomes abundant in pasture lands and alfalfa but, so far as is known, does not reach destructive abundance. It has been reported as being very destructive in Illinois and Kentucky at times.

Food plants and larval habits.—The larvae feed on a large number of plants, and are especially fond of corn and clover. In the Plains region the species occurs chiefly in grasslands. The larvae appear to be particularly sensitive to light, and exposed larvae frantically attempt to gain cover. Crumb (*5*) states that the larvae make permanent tunnels in the soil, with an opening near the plant attacked.

Seasonal history.—There is but one generation annually. The moths emerge in September and deposit their eggs soon thereafter. The eggs hatch in the fall, and the winter is passed as a partly grown larva. In Kansas the larvae are full-grown by the middle of April and soon begin to construct their pupal cells, in which they estivate until pupation begins in August. The adults begin to appear early in September, the heaviest flight occurring late in September and early in October.

Life cycle.—Eggs deposited on October 6 hatched in 12 days. All the larvae molted six times and three molted seven times. The periods required in the various stages and the width of the head capsule in the different larval instars were as follows:

Stage: Instar:	*Period, (days)*	*Width of head capsule (mm.)*
First	11 to 16	0.35 to 0.40
Second	6 to 10	.50 to .55
Third	10 to 107	.70 to .83
Fourth	32 to 114	.90 to 1.30
Fifth	14 to 49	1.40 to 1.80
Sixth	11 to 17	1.80 to 2.45
Seventh	12 to 172	2.60 to 2.75
Eighth [1]	136 to 172	
Total	314 to 356	
Pupa	27 to 40	
Egg to adult	358 to 403	

[1] For 3 individuals having 8 instars.

These larvae were reared in a cave where the temperatures were somewhat lower than those that larvae under field conditions would experience during spring feeding. This condition delayed development so that the life cycle required slightly more than a year.

The pupa ranges from 14 to 20 mm. in length and from 5 to 6 mm. in diameter at the widest point.

Reproductive capacity.—When 7 females reared from the life-cycle series were dissected, the number of eggs contained in the ovaries ranged from 459 to 882, and averaged 690.

Natural enemies.—During 5 years 398 larvae of this species were collected and reared. The mortality due to Hymenoptera was 6 percent, to Diptera 0.7 percent, and to disease 19 percent. The parasites and disease organisms noted were as follows:

Hymenoptera—*Meteorus vulgaris* (Cress.), *Microplitis feltiae* Mues., *Exetastes obscurus* Cress., *Netelia* sp., *Apanteles griffini* Vier., *Ophion* sp.
Diptera—*Winthemia quadripustulata* (F.).
Disease organisms—*Metarrhizium anisopliae* (Metsch), *Sorosporella uvella* (Krass), and undetermined wilt.

Agrotis venerabilis Walker

(Figs. 2, *C*; 4, *E*)

Distribution.—This species is recorded throughout the entire northern United States, in Manitoba and Ontario in Canada, and in California, Colorado, Texas, Tennessee, and Virginia. The writer found the species to be abundant in Kansas and Nebraska.

Economic status.—In cereal and forage crops this species at times is abundant, but no outbreaks have been observed. It has been found in great numbers in pastures, and frequently is a pest in gardens near Manhattan, Kans.

Food plants and larval habits.—The larvae are found most commonly in pastures where little barley (*Hordeum pusillum* Nutt.) is dominant, and also in alfalfa, sweetclover, and roadside vegetation and under dandelion plants in lawns. They make burrows similar to those of *Agrotis gladiaria.*

Seasonal history.—This species has a single brood annually. The adults appear late in September and early in October. This species probably passes the winter as a partly grown larva. In the spring the larvae resume feeding and become full-grown by the last of April. They construct pupal cells and remain inactive in them until pupation begins late in August.

Natural enemies.—Of 511 larvae observed, 2 percent were parasitized by Hymenoptera, 1 percent by Diptera, and 1 percent by nematodes; 11 percent died of disease. The parasites and disease organisms reared were as follows:

Hymenoptera—*Berecyntus* sp., *Zele mellea* (Cress.), *Paranomalon* sp. near *suburbe* (Davis), *Ophion* sp.
Diptera—Bombyliidae, species undetermined.
Nematoda—*Mermis* sp.
Disease organisms—*Metarrhizium anisopliae* (Metsch), undetermined wilt.

Agrotis malefida Guenée

Pale-sided Cutworm

Distribution.—This species is recorded throughout the southern part of the United States and in Cuba and Mexico, but is rare in the central Great Plains. Adults were taken in light traps at Cherryvale, Manhattan, Hays, and Garden City, Kans., and at Lincoln and Scottsbluff, Nebr. They were most abundant at Garden City, where, during 4 seasons, 146 moths were collected at light traps.

Economic status.—The pale-sided cutworm is of no economic importance in the central Great Plains. In the South Jones (*11*) records that this cutworm constitutes 2 percent of the cutworms taken at Baton Rouge, La.

Food plants and larval habits.—Sanderson (*15*) states that in Texas the larvae were taken feeding on potato, cotton, and cabbage. Riley (*14*) reports that the larvae live in tunnels into which they drag their food.

Seasonal history.—The species is of the multiple-generation type. According to Crumb (*5*) there are four broods of this species a year in Texas, where it passes the winter in the pupal stage, and the moths emerge from the last of January to the latter part of March. The second-generation moths appear about the middle of May, and the third brood late in July. The earlier emerging adults of this third brood produce an additional brood whose progeny pupate before cold weather.

The writer has taken adults from late in June to late in October at Garden City. They may have been strays from the South, but it seems quite probable that the species occupies a position similar to that of the fall armyworm, which does not pass the winter successfully in the central Great Plains but reestablishes itself annually from more southern infestations.

Reproductive capacity.—Eight females, taken at light traps at Garden City on November 16, 1934, were dissected; 6 were spent, 1 contained undeveloped eggs, and 1 contained 1,582 eggs.

Agrotis ypsilon (Rottemburg)

Black Cutworm

(Figs. 2, *D*; 4, *H*; 7, *F*)

Distribution.—The black cutworm occurs throughout the United States, in southern Canada, in Mexico, Hawaii, South America Europe, Egypt, Rhodesia, Asia, East Indies, New Zealand, and Australia, and is one of the most widely distributed of the cutworms.

Economic status.—In the central Great Plains region the black cutworm is of minor importance, but at times it increases to destructive numbers locally after floods. East of the Mississippi River it is a pest of considerable importance.

Food plants and larval habits.—The black cutworm feeds on a wide variety of plants, but in the Plains States it is principally a pest of young corn. The larvae are destructive out of proportion to the food they consume, as they often cut off plants, apparently only to satisfy this instinct, and quickly move on to other plants to repeat the process.

The larvae make burrows into which they drag their food. They are very pugnacious and on being touched will strike and bite viciously, exuding a green fluid from the mouth. Some of the larger larvae will pinch severely, but in the writer's experience, none can pierce the skin. The larvae are strongly cannibalistic when confined. When eight nearly full-grown larvae, collected in the field, were left overnight in an 8-ounce salve tin, only one remained the next morning. This species exhibits the highest tolerance to moisture of any observed, and prefers moist or wet soil. An outbreak frequently appears in land that has been flooded recently. For this reason the black cutworm is called the overflow worm in some localities.

Seasonal history.—In the central Great Plains adults have been taken every month except December, January, and February. The overlapping of life cycles makes it difficult to determine the number of generations a year, but apparently there are four complete generations and sometimes a partial fifth. A heavy flight of adults usually occurs during September and October, but stragglers are present into November. Attempts to carry these late-emerging adults through the winter have failed. Crumb (*5*) states that in the latitude of Clarksville, Tenn., the pupa is the normal overwintering stage. In Kansas it is probable that this stage carried the species through the winter, although in cages all attempts failed. The larvae are most abundant during May and June.

Reproductive capacity.—When 14 field-collected females were dissected, the number of eggs ranged from 477 to 2,257, with an average of 1,367. Three reared females contained 1,219, 1,692, and 2,032 eggs, respectively, averaging 1,648. Obviously a species with such a high reproductive capacity can increase rapidly to destructive abundance under favorable conditions.

Life cycle.—Spring generation: Eggs deposited on May 10 on alfalfa foliage produced adults on July 16. The eggs were 0.6 to 0.7 mm. in diameter and 0.4 to 0.5 mm. in height. The larval instars were not observed in this generation.

Summer generations: Eggs deposited on July 22 hatched 6 days later and those deposited on August 5 hatched 3 days later. The periods required in the various stages and the width of the head capsule in the different larval instars were as follows:

EGGS DEPOSITED JULY 22

Stage: Instar:	*Period (days)*	*Width of head capsule (mm.)*
First	2 to 3	
Second	1 to 2	
Third	1 to 2	
Fourth	2 to 4	
Fifth	2 to 4	
Sixth	2 to 15	
Seventh	4 to 15	
Eighth [1]	4 to 7	
Total	28 to 34	
Pupa	12 to 15	
Egg to adult	46 to 52	

[1] 2 specimens.

EGGS DEPOSITED AUGUST 5

Instar:	*Period (days)*	*Width of head capsule (mm.)*
First	2 to 4	0.30 to 0.35
Second	1 to 2	.50 to .60
Third	1 to 3	.90 to 1.15
Fourth	2 to 3	1.50 to 2.05
Fifth	3 to 5	2.10 to 3.05
Total	21 to 25	
Pupa	13 to 15	
Egg to adult	38 to 42	

Natural enemies.—Only 36 black cutworm larvae were collected over a period of many years. Of these, 8 percent were parasitized by Hymenoptera and 3 percent by Diptera. *Meteorus vulgaris* (Cress.) was the only parasite reared that could be determined.

SURFACE-FEEDING CUTWORMS

The cutworms of the surface-feeding group feed largely on parts of the host plant close to the ground and sometimes cut off the stems and feed on the fallen plant. During the day they conceal themselves in surface trash or crawl beneath boards, dry cow chips, and similar objects.

Acronycta parallela (Grote)

Distribution.—Adults of this species were captured at light traps at Cherryvale, Manhattan, Hays, and Garden City in Kansas, and at Lincoln and Scottsbluff in Nebraska. Larvae were taken at Wichita, Kans.

Economic status.—The species is of little or no consequence.

Food plants.—Larvae were found in pasture and wastelands where little barley was dominant. They were reared on sprouted wheat.

Seasonal history.—Adults of this species were captured at lights throughout most of the flight season, March to November, which would indicate that the species has more than one generation annually. The larvae were taken only in March and early April, an indication that the winter is passed as partly grown larvae. Those collected in the field in March were nearly full-grown and formed pupal cells of silk mixed with soil early in April. The larvae remained quiescent within their cells until late in July, when pupation began. The adults emerged late in August and early in September.

Natural enemies.—Of 59 larvae that were reared, 2 percent were parasitized by undetermined Hymenoptera and 9 percent died of an unidentified disease.

Euxoa olivia (Morrison)

Distribution.—Adults of *Euxoa olivia* were captured in light traps at Garden City, Kans., and Lincoln and Scottsbluff, Nebr. Larvae were found at Chadron, Nebr. Davis and Dorst (*6*) list this species from Utah.

Economic status.—The species is of only minor importance.

Food plants.—Larvae were found injuring strawberry plants in a home garden at Chadron, Nebr., and four larvae were collected from

corn near there on May 25, 1937. No other injury is known or has been reported. However, the larvae of this species are easily confused with those of *Chorizagrotis auxiliaris*.

Seasonal history.—This species has a single generation annually. Light-trap records for Scottsbluff showed adults to be present during September and early October. The larvae taken at Chadron on May 25 ceased feeding the first week in June and entered the soil. They remained in their cells until the first week in August, when pupation began, the adults emerging during the early part of September.

Natural enemies.—Of 18 larvae reared from a single lot, 1 was parasitized by an undetermined Hymenoptera and 1 died from an unidentified disease.

Euxoa pallipennis (Smith)

Distribution.—Adults of *Euxoa pallipennis* were captured at lights in Hays, Kans., and Lincoln and Scottsbluff, Nebr. They have been reported from Utah by Davis and Dorst (*6*). Larvae were collected at Bird City, Kans., and Lamar, Colo.

Economic status.—This species is of no known economic importance.

Food plants.—Larvae were taken in wheat and in roadside vegetation.

Seasonal history.—This species appears to have but a single generation annually. The adults are present from late in August to early in October. Larvae collected in the field on May 18, 1939, ceased feeding the last week in May, and after constructing their pupal cells estivated until the middle of August, when pupation began. The adults emerged in September. The overwintering stage is not known, but this species probably hibernates as a partly grown larva.

Natural enemies.—No parasites were reared from the limited number of larvae observed, and no disease was noted.

Euxoa detersa (Walker)

Distribution.—Whelan (*23*) reports that this species is found in eastern Canada, Nova Scotia, and the northern United States as far west as Nebraska and Colorado. Tietz (*16*) reports it from Pennsylvania; Dirks (*7*), from Maine. The writer has captured adults at lights at Manhattan, Hays, and Garden City, Kans., and Lincoln and Scottsbluff, Nebr.

Economic status.—This cutworm is of considerable economic importance locally in the sandy-soil section of Nebraska, principally in Holt, Antelope, and Pierce Counties.

Food plants.—Corn is the chief crop attacked, but the species has been reported in other grasses.

Seasonal history.—There is a single generation annually. The adults are present late in August and throughout September. This species probably hibernates as a partly grown larva. Larvae taken late in May ceased feeding early in June, and estivated as larvae within their cells. The adults emerged in August and September.

Natural enemies.—Of 67 larvae that were reared, 7 were parasitized by unidentified Hymenoptera and 2 by unidentified Diptera.

Euxoa velleripennis (Grote)

Distribution.—Adults of *E. velleripennis* were collected at lights in Manhattan, Kans., and Lincoln and Scottsbluff, Nebr. Dirks (*7*) reports this species from Maine; Tietz (*16*), from Pennsylvania.

Economic status.—This species is of no economic importance in the central Great Plains.

Food plants.—The preferred hosts are not known. One larva was found in pasture land near Chadron, Nebr.

Seasonal history.—Although no details are known, the species probably has only a single generation annually. Adults were collected at lights in September and October. One larval specimen was taken on May 2, 1927; it pupated on May 23; and the adult emerged on June 11. This development would indicate the possibility of estivation as an adult.

Chorizagrotis auxiliaris (Grote)

Army Cutworm

(Figs. 2, *L*; 4, *A*; 7, *A*)

Distribution.—This species is distributed throughout the semiarid region of the Great Plains, sometimes extending its range to eastern Kansas. The larvae have been reported in destructive numbers from Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Montana, Wyoming, Colorado, New Mexico, Utah, Idaho, and Oregon. Although heavy flights of adults have been reported from Wisconsin and Iowa, the larvae have not been recorded east of the Mississippi River.

Economic status.—The species is of major economic importance in the semiarid regions of the Great Plains.

Food plants and larval habits.—The larvae feed on a wide variety of plants, although winter wheat and alfalfa are the principal crops damaged. When the larvae are numerous they assume the army habit and, advancing across a wheat or alfalfa field, entirely consume the plants above ground. In many instances the larvae have migrated into such fields from adjacent pasture lands. At other times the infestation apparently originated within the crop attacked.

Seasonal history.—The army cutworm has but a single generation a year. The eggs are deposited in the soil late in September and during October. Ovipositing females move swiftly along the ground, stopping frequently to insert the ovipositor into small cracks in the soil. The eggs hatch in 1 to 2 weeks, and the young larvae feed until cold weather. They pass the winter as partly grown larvae, and no doubt do some feeding in occasional warm periods during the winter months. As soon as the weather warms up late in February or early in March the larvae resume active feeding, and it is during this time that they do the greatest damage. The larvae become full-grown early in April and enter the soil for pupation. The adults begin to appear in May, and in years of abundance are often a nuisance in dwellings and about lights during most of June. This flight immediately after emergence subsides suddenly, and in the central Great Plains the army cutworms estivate as adults.

Adults are seen at high altitudes in the Rocky Mountains. On

August 19, 1936, R. H. Painter, while collecting at about 12,500 feet in the Medicine Bow Mountains, Wyo., noted adults of this species darting about among the rocks. W. L. Schipull, Forest Supervisor, Montezuma National Forest, Colo., reported that on July 13, 1938, he observed thousands of moths in a dense stand of Engelmann spruce and Alpine fir at an elevation of 10,500 feet. The writer observed thousands of moths late in June 1941, in remote canyons of the mountains of northern Nevada at 6,000 to 9,000 feet. They were actively feeding on flowers of various shrubs in bloom at that time. It is not known whether these adults originated locally or were migrants from the Plains.

The moths reappear in September in greatly reduced numbers and begin depositing their eggs. Dissection of females in June showed the eggs to be barely discernible in the ovaries, whereas in September, when the moths emerged from estivation, the eggs were almost fully developed.

Life cycle.—Eggs deposited on October 14, 1925, at Wichita, Kans., hatched in from 8 to 18 days, and the larvae molted seven times before pupating the following April. The periods required for the various stages and the width of the head capsule in the different larval instars were as follows:

Stage: Instar:	*Period (days)*	*Width of head capsule (mm.)*
First	16 to 48	0.30
Second	13 to 73	0.40 to .50
Third	4 to 70	.50 to .80
Fourth	3 to 42	.75 to 1.10
Fifth	6 to 11	1.10 to 1.65
Sixth	4 to 18	1.50 to 2.50
Seventh	9 to 25	1.90 to 3.00
Total	167 to 194	
Pupa	25 to 32	
Egg to adult	216 to 231	

The great variation in the duration of the first to fourth instars was due to differences in the instar in which the larvae hibernated. In spite of these variations the total number of days from egg to adult varied but little.

The pupae were 18 to 22 mm. long and 6 to 7 mm. in diameter.

Reproductive capacity.—The number of eggs dissected from 21 adults collected at lights in Garden City and Manhattan, Kans., September 27 and 28, 1934, ranged from 318 to 2,241, and averaged 1,150. One month later 16 adult females from the same sources were dissected. At that time the smallest number of eggs was 208, the largest 1,325, and the average 661. Undoubtedly a part of the full complement of eggs had been deposited by most of these females before capture. The enormous reproductive capacity of this species, as revealed by dissections, partly explains its ability to produce seemingly sudden outbreaks. After a favorable estivation period large numbers of eggs are deposited, and, if followed by favorable hibernation conditions, innumerable larvae appear the following spring. When growth in native pasture lands affords enough food the larvae do not migrate to cropland. Frequently, however, the most intense infestations are in pastures that have been grossly overgrazed, so that the larvae are forced to migrate to adjoining alfalfa fields or wheatland.

Natural enemies.—During the investigation of this important species outbreaks never occurred in two successive years in a given locality. Field collections of the larvae were made at every opportunity over a period of 20 years. As a result a knowledge of parasitism and disease was gained from rearing larvae taken in various localities in the central Great Plains under conditions of both abundance and scarcity. These data are given in table 2.

TABLE 2.—*Mortalities of larvae of Chorizagrotis auxiliaris caused by various natural enemies, 1921–40*

Year	Larvae observed	Larvae killed by—				Total mortality
		Hymenoptera	Diptera	Nematoda	Disease	
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1921	87	5	2	1	0	8
1922	88	11	0	0	6	17
1923	16	6	0	0	0	6
1924	1	0	0	0	0	0
1925	54	9	0	0	6	15
1926	6	33	0	0	0	33
1927	91	6	2	0	1	9
1928	8	0	0	0	0	0
1929–32 [1]						
1933	5	0	0	0	0	0
1934	211	21	4	0	41	66
1935	378	13	.3	0	57	70
1936	129	18	4	.8	17	40
1937	140	5	10	0	9	24
1938	508	9	10	.2	10	29
1939	6	0	0	0	0	0
1940	152	5	.6	0	3	9

[1] No collections.

The parasites and disease organisms reared from larvae collected in various localities were as follows:

Hymenoptera—*Eubadizon* sp., *Meteorus vulgaris* (Cress.), *Ophion* sp., *Ophion* n. sp., *Exetastes lasius* Cress., *Exetastes* n. sp., *Macrocentrus incompletus* Mues., *Berecyntus bakeri* var. *bakeri* How., *B. bakeri* var. *euxoae* Gir., *Rogas* sp., *Netelia ocellata* (Vier.), *Netelia* sp., *Apanteles griffini* Vier., and *Microplitis feltiae* Mues.

Diptera—Tachinidae (unidentified), Bombyliidae (unidentified), *Poecilanthrax* n. sp., *Anthrax willistoni* Coq., *Neophorocera claripennis* (Macq.).

Disease organisms—*Beauveria* sp., *Isaria* sp., *Metarrhizium anisopliae* (Metsch), *Sorosporella uvella* (Krass), and an unidentified wilt.

FELTIA SUBGOTHICA (Haworth)

Dingy Cutworm

(Figs. 2, *B*; 4, *D*)

Distribution.—The dingy cutworm is one of the most widely distributed species. It is found in Canada and throughout the northern United States and southward to include Virginia, Tennessee, Missouri, Oklahoma, Colorado, Utah, Texas, and New Mexico.

Economic status.—Although one of the most common cutworms, this species is rarely destructively abundant west of the Mississippi River. In one instance it damaged alfalfa in eastern Kansas.

Food plants and larval habits.—The larvae feed on a variety of plants and are most commonly found in pastures and roadside vegetation. They are also prevalent in old stands of alfalfa and in sweetclover. The larvae are rather sluggish and are perhaps the least pugnacious of the cutworms.

Seasonal history.—There is a single generation of the dingy cutworm annually. The eggs are deposited in the soil and on vegetation. The moths are most abundant during September. This cutworm passes the winter as a partly grown larva, and becomes nearly full-grown by the end of March. It has a long period of inhibited development in the Plains States. The larvae become inactive early in April and remain in burrows until pupation begins early in August. The moths begin to emerge late in August. When confined some larvae failed to pupate at the normal time and remained in their burrows long after field emergence was concluded. All attempts to induce these individuals to pupate failed.

Life cycle.—Eggs deposited in September hatched in 6 to 11 days. Most of the larvae passed through six instars, but a few molted seven times before ceasing to feed. The periods required in the various stages and the width of the head capsule in the different larval instars were as follows:

Stage:	*Period (days)*	*Width of head capsule (mm.)*
Egg	5 to 13	----------
Instar:		
First	3 to 12	0.30
Second	4 to 12	0.40 to .50
Third	4 to 12	.55 to .80
Fourth	5 to 17	.80 to 1.25
Fifth	8 to 119	1.30 to 1.90
Sixth	15 to 169	1.90 to 2.50
Seventh	18 to 222	2.30 to 2.80
Eighth	83 to 286	----------
Total	249 to 351	
Pupa	12 to 35	
Egg to adult	277 to 374	

The pupa was 16 to 20 mm. long and 5 to 6 mm. in diameter.

Reproductive capacity.—When 15 reared females were dissected, the minimum number of eggs observed was 791, the maximum 1,406, and the average 1,030. When 6 females taken at bait were dissected, the number of their eggs ranged from 492 to 1,224, and averaged 725.

Natural enemies.—Observations over a period of 14 years on larvae collected in the field in various localities in the central Great Plains are summarized in table 3.

TABLE 3.—*Mortalities of larvae of Feltia subgothica caused by various natural enemies, 1920–39*

Year	Larvae observed	Larvae killed by—			Total mortality
		Hymenoptera	Diptera	Disease	
	Number	*Percent*	*Percent*	*Percent*	*Percent*
1920	81	0	0	0	0
1921	46	2	0	0	2
1922	188	4	.5	0	4
1923	6	0	0	0	0
1924	5	0	0	0	0
1925	69	13	0	1	14
1926	114	22	4	0	26
1927	48	8	2	0	10
1928–33 [1]					
1934	26	0	4	8	12
1935	143	10	1	17	28
1936	206	7	3	4	14
1937	501	15	2	3	21
1938	230	7	.4	3	10
1939	8	12	0	0	12

[1] No collections.

The parasites and disease organisms reared from the larvae were as follows:

Hymenoptera—*Microplitis feltiae* Mues., *Rogas* n. sp., *Campoletis perdistinctus* (Vier.), *Campoletis oxylus* (Cress.), *Liothorax melanocera* Ashm., *Berecyntus bakeri* var. *bakeri* How., *B. bakeri* var. *euxoae* Gir., and *Meteorus vulgaris* (Cress.).

Disease organisms—*Metarrhizium anisopliae* (Metsch), *Beauveria* sp., and an unidentified wilt.

FELTIA SUBTERRANEA (Fabricius)

Granulate Cutworm

(Figs. 2, *E*; 4, *G*; 7, *E*)

Distribution.—Crumb (*5*) states that this species is distributed from Massachusetts and New York westward to South Dakota, Arizona, and California, but that it probably does not breed regularly in the northern parts of this range. It is most abundant in the extreme South. It also is found in the Bahama Islands, Puerto Rico, Central America, and South America. The writer has taken adults at light traps at Cherryvale, Manhattan, Hays, and Garden City, Kans., and at Lincoln, Nebr. None were collected in three seasons at Scottsbluff, Nebr.

Economic status.—In the central Great Plains this cutworm is of very minor economic importance. In the South, however, it is of considerable importance. Jones (*11*) says that in collections of cutworms at Baton Rouge, La., 94 percent were *Feltia subterranea*.

Food plants and larval habits.—The larvae feed on a wide range of plants, particularly vegetable crops. Jones (*11*) notes three types of feeding—cutting off small plants near the surface of the ground,

climbing the plant and feeding on the foliage, and boring into tomatoes and eggplant fruits if they rest upon the ground. Crumb (*5*) reports that when tobacco plants become too large for the larvae to sever the stem, they climb the plants, sever the midribs of leaves near the base of the plant, and then feed on the portion lying on the ground. He also says that the larvae can live at least a month on dry vegetation.

In the central Great Plains the larvae have been collected most frequently in the fall in alfalfa just beneath the soil surface, and sometimes even partly exposed. Dust particles covering the body make detection difficult in such places.

Seasonal history.—Jones reports this species produced five full generations annually in the South, and a partial sixth in Louisiana. Crumb states that in Tennessee there are three full broods and a partial fourth, and that the species overwinters as a pupa. In the central Great Plains region larvae were never found in abundance, so that the seasonal history is incomplete. Adults were taken at lights in Manhattan, Kans., from April to October, the greatest number in September. This leads to the belief that the species does not normally hibernate in the latitudes of the Great Plains, but reestablishes itself each year from northward migration of the adults.

Life cycle.—Summer generation: Eggs deposited on July 30 hatched in 5 days. The periods required in the various stages were as follows:

Stage: Instar:	Period (days)
First	3
Second	2 to 4
Third	2 to 5
Fourth	2 to 5
Fifth	3 to 7
Sixth	5 to 9
Seventh	14 to 16
Total	38 to 40
Pupa	21
Egg to adult	64 to 66

Fall generation: Eggs deposited on September 10 hatched in 6 days. During the winter the larvae were kept in a cave where the temperature never fell below the freezing point. Out of 138 larvae, however, only 1 reached the adult stage, although all pupated before November 1. This development would indicate that the species is not adapted to the region, even when protected from freezing temperatures, for the pupal period is extended beyond the limits of tolerance of the species to low temperatures.

Most of the larvae in this series molted five times, but a few passed through an additional instar. The periods required in the various stages and the width of the head capsule in the different larval instars were as follows:

Stage: Instar:	Period (days)	Width of head capsule (mm.)
First	2 to 3	0.35 to 0.40
Second	2 to 3	.50 to .60
Third	3 to 7	.85 to 1.05
Fourth	3 to 7	1.30 to 1.70
Fifth	4 to 6	2.00 to 2.50
Sixth	16 to 28	3.20 to 3.70
Total	33 to 70	
Pupa	[1] 185	
Egg to adult	[1] 253	

[1] 1 specimen.

The eggs were 0.6 to 0.7 mm. in diameter and 0.4 to 0.5 mm. in height. The pupae were 18 to 20 mm. in length and 5.5 to 6.3 mm. in diameter.

Reproductive capacity.—One female taken at light, when dissected, contained 710 eggs.

Natural enemies.—Only 5 larvae of this species were collected in the central Great Plains region during this investigation; none were parasitized or diseased.

Lacinipolia meditata (Grote)

(Figs. 2, *J*; 4, *L*; 7, *G*)

Distribution.—The recorded distribution of this species includes the Atlantic Coast States from Maine to North Carolina and westward to Tennessee, Illinois, Missouri, Kansas, and South Dakota. One adult was taken in the light trap at Scottsbluff, Nebr.

Economic status.—This species is of no economic importance in the central Great Plains and of only minor importance elsewhere.

Food plants and larval habits.—The recorded food plants are tobacco, clover, solidago, *Aster ericoides* L., bluegrass, and *Andropogon virginicus* L. The writer has taken the larvae in pasture lands, prairie hay meadows, and roadside grasses and weeds, where little barley (*Hordeum pusillum* Nutt.) was predominant. The larvae are rather sluggish. They do not burrow into the soil, but prefer to hide in surface litter. Although this species has never been recorded as injuring growing wheat, it is at least a potential enemy, as the writer reared this cutworm on sprouted wheat.

Seasonal history.—This species has but one generation a year. The adults appear late in August and are present throughout September. In cages the eggs are deposited in or on the surface of the soil and hatch soon thereafter. These cutworms pass the winter as partly grown larvae, which resume feeding early the following spring, becoming full-grown in March. By the first week in April they cease feeding and form their pupal cells of silk mixed with soil. They remain inactive in their cells until pupation begins late in July and early in August. After a pupal period of 3 to 4 weeks the adults appear and begin depositing eggs for the next generation.

Life cycle.—Eggs deposited on September 20 hatched in 7 days. The larvae passed through five, six, and seven instars, the majority having six. The periods required in the various stages and the width of the head capsule in the different larval instars were as follows:

Stage:	*Period (days)*	*Width of head capsule (mm.)*
Egg	7	----------
Instar:		
First	7 to 36	0.30 to 0.40
Second	4 to 24	.40 to .55
Third	6 to 70	.65 to .85
Fourth	10 to 40	1.00 to 1.40
Fifth	18 to 119	1.30 to 2.00
Sixth	52 to 100	1.90 to 2.40
Seventh [1]	140 to 180	
Total	255 to 336	
Pupa	20 to 30	
Egg to adult	284 to 367	

[1] Estivation included.

Natural enemies.—The larvae of *Lacinipolia meditata* were never numerous during this investigation. A total of 78 field-collected larvae were reared, of which 1 percent were parasitized by an unidentified species of *Ophion* and 14 percent died of an unidentified wilt disease.

Lacinipolia vicina (Grote)

Distribution.—Holland (*10*) records this species as ranging from the Atlantic to the Pacific Oceans. It is also recorded from New York and Pennsylvania, and the writer has taken the adults in Kansas and Nebraska.

Economic status.—This cutworm is of no economic importance.

Food plants.—During many years of collecting, only three larvae of this species were taken. They were found in surface trash at the edge of a field of winter wheat.

Seasonal history.—Little is known of the seasonal history of the species. The three larvae, taken on March 21, were then about half grown. They pupated early in May and the adults emerged in June and July. Records of capture at light traps showed that a few adults were present early in the season, but that the heaviest flight occurred in September. This would indicate that the species has at least two generations annually, and, as larvae were present in March, they probably pass the winter as partly grown larvae.

Lacinipolia renigera (Stephens)

Bristly Cutworm

(Figs. 2, *F*; 4, *I*)

Distribution.—The range of this species includes the eastern United States and extends as far west as North Dakota, Nebraska, Kansas, Colorado, and New Mexico. It also occurs in Europe.

Economic status.—It is of no economic importance in the central Great Plains. Elsewhere in its range it is at times destructively abundant locally.

Food plants and larval habits.—This species is a general feeder. The food plants include alfalfa, clover, corn, tobacco, and turnips. The protective coloration of the larvae is remarkable. Stretched out among the bits of dead stems and litter in which it prefers to rest, the larva is difficult to discern. Furthermore, it clings to a stem when disturbed, not coiling as do so many cutworms, and, being covered with dust particles, it blends almost perfectly into its surroundings.

Seasonal history.—So far as known, the bristly cutworm has two generations a year over its entire range. It passes the winter as partly grown larvae, which reach maturity by the end of March. Nearly all have pupated by the end of April. The moths of the spring brood appear early in May and are present until the last of June. These moths give rise to the summer generation, the moths of which appear late in August, that flight continuing until early in October. Eggs deposited by these adults produce the overwintering larvae.

Life cycle.—Winter generation: Eggs deposited on October 3 hatched on October 10 and 11. The larvae passed through six or

seven instars, but most of them through seven. The periods required in the various stages and the width of the head capsule in the different larval instars were as follows:

Stage: Instar:	*Period (days)*	*Width of head capsule (mm.)*
First	6 to 10	0.35 to 0.40
Second	8 to 20	.45 to .55
Third	10 to 29	.60 to .80
Fourth	72 to 111	.75 to 1.05
Fifth	13 to 35	1.10 to 1.50
Sixth [1]	28 to 37	1.60 to 1.90
Sixth [2]	13 to 31	
Seventh	14 to 31	
Total	183 to 223	
Pupa	19 to 28	
Egg to adult	212 to 240	

[1] Larvae having 6 instars.
[2] Larvae having 7 instars.

Summer generation: Eggs deposited on May 18 hatched in 7 days; those deposited on May 20 hatched in 5 days. The periods required in the various stages were as follows:

Stage: Instar:	*Period (days)*
First	4 to 9
Second	4 to 12
Third	4 to 14
Fourth	6 to 17
Fifth	3 to 16
Sixth [1]	19 to 36
Sixth [2]	7 to 20
Seventh	20 to 42
Total	51 to 91
Pupa	13 to 16
Egg to adult	80 to 111

[1] Larvae having 6 instars.
[2] Larvae having 7 instars.

The eggs were 0.64 to 0.69 mm. in diameter; the pupae 12 to 16 mm. long, and 0.39 to 0.57 mm. in diameter.

Reproductive capacity.—Three females when dissected contained an average of 518 eggs.

Natural enemies.—Of 16 field-collected larvae reared, 1 was parasitized by *Berecyntus bakeri* var. *bakeri* How.

Orthodes (formerly Eriopyga) incincta (Morrison)

(Figs. 2, *K*; 4, *N*; 5, *A*; 7, *I*)

A discussion of this species was published by the writer (*17*) in 1937.

Distribution.—According to records of the Bureau of Entomology and Plant Quarantine, the species ranges from Illinois to the Pacific coast.

Economic status.—It is of minor economic importance in the central Great Plains.

Food plants.—The larvae were taken under surface trash, along roadside hedges, and in grassy areas where little barley (*Hordeum pusillum* Nutt.) was the predominant species of grass.

Seasonal history.—There is but one generation annually. The adults are present from late in August to mid-October. The eggs hatch in 8 to 32 days after deposition in or on the surface of the soil, and the species passes the winter as partially grown larvae.

Feeding is resumed the following spring, and by May 15 the larvae are full-grown. Shortly thereafter they enter the soil, construct pupal cells of silk mixed with soil, and by the end of May have transformed into the pupal stage. They pass the summer in that stage, and the adults emerge from August to October, depending on the locality.

Reproductive capacity.—The number of eggs from 21 females dissected ranged from 470 to 1,173 and averaged 877.

Natural enemies.—Over a period of several years 102 field-collected larvae were reared. Of this number 8 percent were killed by fungus diseases and 11 percent by hymenopterous parasites.

Nephelodes emmedonia (Cramer)

Bronzed Cutworm

(Figs. 2, *H*; 4, *K*)

Notes on this species were published by the writer (*19*) in 1937.

Distribution.—This cutworm is recorded throughout the northern part of the United States east of the Rocky Mountains, with Colorado, Kansas, Missouri, Tennessee, and Virginia as the approximate southern limit of its range. It also occurs in injurious numbers in eastern Canada, particularly in New Brunswick (Gibson *8*).

Economic importance.—The species is of minor economic importance in the central Great Plains. However, it is important in northeastern United States and eastern Canada.

Food plants.—The larvae show a pronounced preference for bluegrass (*Poa* spp.), and may be found deep in the crowns of this grass. They also feed on Virginia wild-rye (*Elymus virginicus* L.) and on the buds and leaves in fruit trees. Hence this species has the habits of both surface and climbing cutworms.

Seasonal history.—There is but one generation annually in the central Great Plains. The adults emerge about mid-September and are present until the early part of October. The females oviposit shortly after emergence, but the eggs do not hatch until the following spring. The larvae become full-grown by the last of April and cease feeding during the first 10 days of May. They then enter the soil and form the pupal cells, remaining quiescent therein until pupation begins about August 15. The pupal period takes about 4 weeks. The seasonal cycle is completed with the emergence of the adults in September and October.

Reproductive capacity.—The number of eggs dissected from 16 females ranged from 533 to 1,381 and averaged 1,071.

Natural enemies.—Of 169 larvae collected at various times from bluegrass, 1 percent were parasitized by undetermined Hymenoptera, and 1 percent were killed by undetermined fungus disease and 32 percent by a wilt which quickly liquefied the larvae.

Septis cariosa (Guenée)

(Fig. 4, *W*)

Distribution.—This species is recorded from the northern United States, including New York and Pennsylvania, and from Arizona. The writer has collected larvae and adults in Kansas

Economic status.—This species is of no economic importance.

Food plants.—The larvae were taken in little barley and around the bases of clumps of volunteer wheat.

Seasonal history.—Little is known of the seasonal activities of this species. Full-grown larvae were taken late in March and early in April, an indication that it passes the winter as a partly grown larva. The larvae pupated early in April and produced adults the last of April and early in May. This species probably has two or more generations a year.

Dipterygia scabriuscula (Linnaeus)

(Fig. 4, *V*)

Distribution.—Holland (*10*) gives the distribution of *Dipterygia scabriuscula* as being from the Atlantic coast westward to the Rocky Mountains. Adults were taken at lights in Cherryvale, Manhattan, and Garden City, Kans., and at Lincoln and Scottsbluff, Nebr.

Economic status.—This species is of no economic importance.

Food plants.—Larvae fed readily on dock (*Rumex* sp.) in captivity, but would not feed on knotweed (*Polygonum* sp.), alfalfa, clover, wheat, grape, carrot, beet, bean, and calendula. No host plant other than dock is known.

Seasonal history.—Adults were taken in light traps from April to September, an indication that the species is multiple-brooded. No other stages were found in the field. Under cage conditions in July the moths deposited their eggs singly among the soil particles at the ground surface. The eggs hatched in 4 to 5 days. The larvae developed rapidly, but failed to reach the pupal stage because the supply of dock was exhausted and all larvae perished.

Elaphria (formerly Monodes) grata (Hübner)

Distribution.—This species has been recorded from the Atlantic States only. However, adults were collected at lights in Manhattan, Kans., which would indicate a more extensive range.

Economic status.—This species is not known to be of any economic importance.

Food plants.—No information is available on the host plants.

Seasonal history.—One larva taken in surface trash on February 6 pupated on February 21, and the adult emerged on March 19.

Platyperigea (formerly Athetis) meralis (Morrison)

Distribution.—According to Holland (*10*), this species is recorded from the Atlantic seaboard to the interior of New Mexico and is common in Texas. The adults were caught at lights in Manhattan, Kans., and larvae were taken at Chadron, Nebr., and at Wichita, Kans.

Economic status.—This species is not known to be of any economic importance.

Food plants.—No information is available on the host plants.

Seasonal history.—One larva, taken in pasture land near Chadron on May 2, constructed a silk-soil cell on May 10, and the adult emerged on June 4. An adult emerged on May 2 from a pupa taken on April 18.

Laphygma frugiperda (Abbott and Smith)

Fall Armyworm

(Figs. 4, *M*; 7, *H*)

Distribution.—The fall armyworm is distributed generally throughout the United States east of the Rocky Mountains and in the Tropics.

Economic status.—It is of major economic importance in the central Great Plains. Frequently the ears of late-planted corn are damaged, and large areas of newly sown winter wheat are destroyed.

Food plants and larval habits.—The larvae are general feeders, but show a preference for various grasses. Besides damaging young winter wheat and late corn, the larvae are destructive to lawn grasses, particularly Bermuda grass and creeping bentgrass. Sometimes they attack alfalfa. They consume the entire young winter wheat plant above ground, necessitating the reseeding of large areas. However, in late corn the larvae bore into the ears and central shoots, an indication that this species has the habits of both surface and climbing cutworms.

Seasonal history.—This is the only species of cutworm of economic importance in the central Great Plains that is known to be unable to survive the winter there. According to Luginbill (*12*), the fall armyworm survives the winter only in southern Florida and southern Texas, or in the semitropical and tropical zones. Thus it must redistribute itself each year by migration of the adults. In Kansas these cutworms usually appear early in August, and light-trap records showed them to be present until the first week in November. All attempts to overwinter the species in any of its stages have failed. Generally there is one generation, with a partial second in Kansas. The larvae are most numerous late in August and in September. The females deposit their eggs in masses on foliage, fence posts, and other objects, and cover them with scales from their bodies. The small larvae, on hatching, spin down to the food plants on silken threads. The ability to spin is lost after the first larval instar.

Natural enemies.—Of 120 field-collected larvae, 18 percent were parasitized by Hymenoptera and 3 percent by Diptera. The parasites reared were as follows:

Hymenoptera—*Pristomerus* (*Neopristomerus*) *appalachianus* Vier; *Zele mellea* (Cress.), *Chelonus texanus* Cress.
Diptera—*Winthemia quadripustulata* (F.), *Euphorocera tachinomoides* (Tns.).

Epizeuxis lubricalis Geyer

Distribution.—This species is recorded generally throughout the United States and Canada.

Economic status.—This species is of no economic importance.

Food plants.—The larvae always are reported in association with rotten wood, but whether they feed on wood or on fungi growing on the wood is not known.

Seasonal history.—Only two larvae were collected. They were found late in March under a board at the edge of a wheat field, an indication that they passed the winter as partly grown larvae. They pupated within cocoons attached to the cover of the salve tins in which they were reared. The adults emerged the first week in May.

Bleptina caradrinalis Guenée

Distribution.—Holland (*10*) recorded the distribution of *Bleptina caradrinalis* to be from Canada to the Gulf of Mexico and westward to the Rocky Mountains.

Economic status.—This species is of no importance.

Food plants.—No information is available on the host plants.

Seasonal history.—Only five larvae were collected. They were taken late in January and early in February at Wichita, Kans., which would indicate that they overwintered as partly grown larvae. Adults emerged late in April and early in May. Pupal cells were constructed of silk mixed with soil.

CLIMBING CUTWORMS

This group includes numerous species that climb the host plant to feed on foliage, stems, buds, or fruit. They hide during the day under surface trash, boards, or other objects, and emerge at night for feeding. They may be easily located on the host plants with a flashlight.

Euxoa niveilinea (Grote)

Distribution.—According to Whelan (*23*), this species has been reported from Nebraska, Kansas, Colorado, New Mexico and Texas. The writer has taken adults in Kansas and adults and larvae in Nebraska.

Economic status.—This cutworm is important in the sandy-soil region of Nebraska, particularly in Holt, Antelope, and Pierce Counties.

Food plants.—Corn is the principal crop attacked, although this cutworm has also been reported on sweetclover and wheat.

Seasonal history.—This species has only one generation a year. The adults emerge in September and October. The hibernating stage is not known, but is probably the partly grown larva. The larvae mature late in May and early in June, construct their pupal cells and remain quiescent throughout the summer. They pupate in August.

Euxoa scandens (Riley)

White Cutworm

Distribution.—White cutworm adults were captured at lights in Lincoln and Scottsbluff, Nebr., being abundant in Scottsbluff. Gibson (*8*) reports the distribution in Canada to be from Manitoba to the Maritime Provinces.

Economic status.—Gibson records the species as seriously damaging vegetables and the buds of fruit trees. There are no records of it being destructively abundant in the central Great Plains. The writer has taken the larvae only in wastelands.

Food plants.—The larvae have been collected about the bases of large flowered dock (*Rumex venosus* Pursh.), in sweetclover, and among willow sprouts along irrigation ditches. Gibson records as its favorite food the buds and tender leaves of fruit trees.

Seasonal history.—This species has a single generation a year. Adults were captured from late in May to early in August at lights

in Scottsbluff, Nebr. Larvae taken at Bayard, Nebr., on May 22, 1936, ceased feeding early in June and pupated within a few days. The adults emerged late in June and throughout July. Gibson states that the insect hibernates as a half-grown larva. Nothing is known of its seasonal history between the emergence of adults and the appearance of larvae, but the species probably estivates as an adult and deposits eggs in the fall.

Natural enemies.—A total of 164 field-collected larvae were reared during 1936–37. They were taken in wastelands along roadsides and irrigation ditches in Kansas and Nebraska. Of the larvae collected, 11 percent were parasitized by Hymenoptera and 4 percent by Diptera and 8 percent were killed by disease. The parasites and disease organisms reared were as follows:

Hymenoptera—*Berecyntus bakeri* var. *euxoae* Gir.
Diptera—*Anthrax willistoni* Coq.
Disease organisms—*Metarrhizium anisopliae* (Metsch), an unidentified wilt.

Euxoa messoria (Harris)

Dark-sided Cutworm

Distribution.—Crumb (*5*) records this species throughout the breadth of Canada and the United States and at least as far south as northern Tennessee. Gibson (*8*) reports it to be in greatest abundance in Ontario and Quebec.

Economic status.—This species is of minor economic importance in the central Great Plains, but is destructively abundant in the sandhill region of Nebraska.

Food plants and larval habits.—The climbing habit has been well developed in this cutworm, so that it feeds on a wide range of plants. It is recorded as being particularly injurious to buds of trees and shrubs. In Nebraska, its chief damage is to corn when the plants are 2 to 4 inches high, so that at times replanting is necessary.

Seasonal history.—There is only a single generation of this species each year. Larvae collected in May in Nebraska and reared at Manhattan, Kans., became full-grown early in June and pupated soon thereafter. Adults emerged throughout July and the first part of August. Crumb states that in Tennessee, eggs are deposited in the fall and hatch the following spring.

Natural enemies.—Of 312 larvae collected in Nebraska and Kansas during 1935–39, 12 percent were parasitized by Hymenoptera and 2 percent by Diptera and 11 percent were killed by disease. The parasites and disease organisms reared were as follows:

Hymenoptera—*Berecyntus bakeri* var. *euxoae* Gir., *Meteorus vulgaris* Cress,. *Exetastes* sp.
Diptera—Bombyliidae, unidentifiable.
Disease organisms—*Metarrhizium anisopliae* (Metsch), *Sorosporella uvella* (Krass), an unidentified wilt.

Euxoa tessellata (Harris)

Striped Cutworm

Distribution.—This species is widely distributed in northern United States, the range extending southward to Kansas. Adults were captured abundantly at lights in Scottsbluff, Nebr.

Economic status.—This species is of no economic importance in the central Great Plains.

Food plants.—The larvae feed on a wide range of plants, including garden crops, and on the foliage of apple, cherry, and pear trees.

Seasonal history.—No larvae were collected. Adults were common at lights in Scottsbluff from May to August.

Agrotis (formerly Porosagrotis) vetusta (Walker)

(Figs. 2, *N*; 4, *B*; 7, *B*)

Distribution.—*A. vetusta* is recorded from along the Atlantic coast from Nova Scotia to Georgia, and from Michigan, Colorado, British Columbia, Washington, and Oregon. Davis and Dorst (*6*) reported this species from Utah. The writer has taken both adults and larvae in Kansas, Colorado, and Nebraska.

Economic status.—In the central Great Plains the species is of no consequence economically. No destructive abundance has ever been seen by or reported to the writer. However, Chittenden (*3*) reports this species to be an important pest along the Atlantic seaboard.

Food plants.—Chittenden (*3*) states that the larvae feed on garden plants, tobacco, cotton, and the buds and leaves of berry vines and young peach trees. The writer has taken the larvae in gardens and wastelands.

Seasonal history.—This species produces a single generation a year. Larvae collected in May reached maturity late that month and, after constructing their pupal cells, remained quiescent until pupation began late in August. Adults emerged in September. Apparently this species passes the winter as a partly grown larva.

Natural enemies.—Of 23 larvae reared in 1939, 1 was parasitized by an unidentified Hymenoptera and 13 developed the fungus disease caused by *Sorosporella uvella* (Krass).

Spaelotis clandestina (Harris)

W-marked Cutworm

Distribution.—Whelan (*23*) reports this species to be of northern distribution—in Canada and in the northern United States as far south as Kentucky, Missouri, Kansas, Colorado, Utah, Nevada, and California. It was taken only at lights in Scottsbluff, Nebr.

Economic status.—This species is of no economic importance in the central Great Plains.

Anicla (formerly Lycophotia) infecta (Ochsenheimer)

(Figs. 4, *Z*; 7, *R*)

Distribution.—Crumb (5) records the species to be distributed generally over the United States, east of, and including, the States from North Dakota to Texas, but probably most abundant in the South. It is found also in Manitoba, Canada, and in South America as far south as Brazil.

Economic status.—This species is of no economic importance in the central Great Plains. It is of minor importance in the South.

Seasonal history.—It is doubtful if this species passes the winter

successfully in the Great Plains region. Adults were never numerous, and only one larva was collected. Adults were taken at lights during July and August.

Life cycle.—At Wichita, Kans., eggs deposited on August 24 hatched in 5 days. They were 0.58 to 0.61 mm. in diameter and 0.42 to 0.53 mm. in height. The periods required in the various stages and the width of the head capsule in the different larval instars were as follows:

Stage: Instar:	*Period (days)*	*Width of head capsule (mm.)*
First	3 to 4	0.35 to 0.40
Second	2 to 3	.55 to .70
Third	2 to 5	.85 to 1.10
Fourth	2 to 5	1.40 to 1.60
Fifth	2 to 8	1.80 to 2.35
Sixth	6 to 11	
Total	19 to 24	
Pupa	24 to 38	
Egg to adult	48 to 64	

Reproductive capacity.—Two females taken at bait, when dissected, contained 862 and 722 eggs.

Peridroma margaritosa (Haworth)

Variegated Cutworm

(Figs. 4, *S*; 5, *C*; 7, *M*)

Distribution.—Crumb (*5*) states that this species occurs in the Americas from Alaska to Patagonia and in Europe and the Mediterranean region generally.

Economic status.—It is of major economic importance over much of the United States, and in the central Great Plains it is at times very destructive in alfalfa and sweetclover.

Food plants and larval habits.—The list of food plants is extensive. When the larvae occur in great numbers, they assume the army habit. This species is not entirely nocturnal, and frequently feeds in the daytime, especially on cloudy or partly cloudy days. In their younger stages the larvae rest on the plants, but the larger larvae have a tendency to hide during the day.

Seasonal history.—In Kansas the adults have been taken every month except December, January, and February. Because all stages may be found in the field in May and June, it is difficult to determine from field observations the number of generations a year. Crumb (*5*) states that there are four in Tennessee. The writer has reared three and a partial fourth generation in one year at Manhattan, Kans. In the central Great Plains the important generation is the one that is in the larval stage during May and June, because the others are reduced to small numbers by repressive factors. During the summer the adults are scarce, but the number increases gradually until cold weather comes in the fall. All attempts to carry the larvae through the winter, either in outdoor cages or in the laboratory, have failed. The pupa appears to be the usual overwintering stage, but survival is low even during normal winters. The relatively few survivors are able to carry the species to high population levels, owing to their enormous reproductive capacity.

Life cycle.—Spring generation: Eggs deposited on April 14 hatched in 9 days. The periods required in the various stages were as follows:

Stage: Instar:	Period (days)	Stage—Continued Instar—Continued	Period (days)
First	5	Sixth	12 to 23
Second	3 to 4		
Third	3 to 5	Total	35 to 49
Fourth	3 to 7	Pupa	12 to 18
Fifth	5 to 8	Egg to adult	58 to 69

Summer generation: Eggs deposited on June 30 hatched in 4 days. The periods required in the various stages and the width of the head capsule in the different larval instars were as follows:

Stage: Instar:	Period (days)	Width of head capsule (mm.)
First	3 to 9	0.30 to 0.35
Second	2 to 7	.50 to .62
Third	2 to 9	.80 to 1.00
Fourth	2 to 10	1.40 to 1.65
Fifth	2 to 21	2.20 to 2.60
Sixth	2 to 21	2.80
Seventh	10 to 27	
Total	35 to 60	
Pupa	12 to 23	
Egg to adult	59 to 78	

Fall generation: Eggs deposited on September 17 hatched in 5 days. The material was kept in an unheated outdoor insectary until November 8, when it was transferred to an unheated basement where the temperature occasionally fell a few degrees below the freezing point. The periods required in the various stages were as follows:

Stage: Instar:	Period (days)	Stage—Continued Instar—Continued	Period (days)
First	3 to 4	Sixth	11 to 16
Second	3 to 4		
Third	4 to 5	Total	33 to 40
Fourth	4 to 7	Pupa	60 to 107
Fifth	6 to 8	Egg to adult	101 to 152

The pupae were 15 to 20 mm. long and 5 to 6.5 mm. in diameter.

Reproductive capacity.—In 12 adults that were reared and dissected, the maximum number of eggs was 2,696, the minimum 1,185, and the average 2,111. The fecundity of this species is greater than that of any other species observed. Under favorable conditions a species with such a high reproduction potential can increase quickly to outbreak proportions.

Natural enemies.—Because of the fluctuations in the numbers of this species in the central Great Plains, a special effort was made to collect larvae in the field under conditions of both scarcity and abundance. Larvae so collected were reared individually in salve tins partially filled with sterilized soil, and the kind and degree of infestation of parasites and disease organisms were noted. A summary of these results is given in table 4.

TABLE 4.—*Mortalities of larvae of Peridroma margaritosa caused by various natural enemies, 1920–40*

Year	Larvae observed	Larvae killed by—				Total mortality
		Hymenoptera	Diptera	Nematoda	Disease	
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1920	65	14	3	0	2	19
1921	2	0	0	0	0	0
1922	2	0	0	0	0	0
1923	1	100	0	0	0	100
1924–26 [1]						
1927	4	0	0	0	0	0
1928–32 [1]						
1933	1	0	100	0	0	100
1934	2	0	0	0	0	0
1935	510	1	11	.6	7	20
1936 [1]						
1937	732	6	10	.3	6	22
1938	101	53	7	1	14	75
1939	30	33	43	0	3	79
1940	175	18	25	0	7	50

[1] No collections.

The following parasites and disease organisms were reared from field-collected larvae:

Hymenoptera—*Apanteles griffini* Vier., *Apanteles militaris* (Walsh), *Campoletis perdistinctus* (Vier.), *Ophion* sp., *Ophion ancyloneura* Cam., *Meteorus vulgaris* (Cress.).
Diptera—*Archytas analis* (F.), *A. apicifera* (Wlk.), *Schizocerophaga* sp., *Salmacia* sp. probably *sequax* (Will.), *Poecilanthrax halcyon* (Say).
Disease organisms—Unidentified wilt, *Metarrhizium anisopliae* (Metsch).

AMATHES (formerly NOCTUA) C-NIGRUM (Linnaeus)

Spotted Cutworm

(Figs. 4, *U*; 7, *O*)

Distribution.—This species is recorded from Canada and in the United States as far south as Virginia, Tennessee, Kansas, and Arizona; also from Alaska, Europe, and Asia.

Economic status.—It is of minor economic importance in the central Great Plains. In northeastern United States it is an important garden pest.

Food plants.—The spotted cutworm is a general feeder and is reputed to be one of our most destructive cutworms in its range of abundance. In the central Great Plains it has never appeared in damaging numbers, and is collected chiefly in pasture grasses and wastelands.

Seasonal history.—There are apparently two generations a year in Kansas. Two distinct periods of adult flight were evident from light-trap records for Manhattan, 1935–37, one beginning the first week in May and extending to the middle of June, and the other beginning

about the middle of August and ending early in October. All attempts to carry the larvae through the summer failed. This species passed the winter as a partly grown larva. The larvae reached maturity early in April and the moths emerged in May and June. Eggs deposited by these adults produced larvae which were nearly mature by the last of June. In rearing work all these larvae died suddenly during the first heat of summer early in July.

Natural enemies.—Of 22 larvae collected in the field, none were parasitized or diseased.

Anicla (formerly Agrotis) badinodis (Grote)

(Figs. 4, *T*; 5, *D*; 7, *N*)

A discussion of this species was published by the writer (*18*) in 1937.

Distribution.—The recorded distribution of this cutworm includes Canada and the Atlantic Coast States from New York to North Carolina, and westward to Iowa, Kansas, and Texas.

Economic status.—This species is of no economic importance in the central Great Plains.

Food plants.—Crumb (*5*) records among its food plants, clover, *Rumex crispus* L., *Sisymbrium officinale* L., chickweed, *Aster ericoides* L., and tobacco. The writer has taken the larvae in clumps of volunteer wheat, in surface trash along roadside hedges, and in grassy areas adjoining wheat and alfalfa fields; also at night feeding on the tender leaves of alfalfa.

Seasonal history.—This species has one generation annually. The adults appear early in October and in some years are present until the first week in November. The eggs are deposited soon after the females emerge and hatch in about 2 weeks. This species passes the winter in the larval stage. By April 20 of the following spring the larvae have reached maturity and entered the soil for pupation. They pass the summer in the pupal stage, and the adults emerge in October, thereby completing the yearly cycle.

Reproductive capacity.—When 17 females, reared from egg to adult in the laboratory, were dissected, the number of eggs ranged from 536 to 1,300 and averaged 880.

Natural enemies.—Larvae were never numerous, and over a period of several years only 38 were collected. Of this number 11 percent were parasitized by undetermined Hymenoptera and 5 percent were killed by fungus disease.

Rhynchagrotis cupida (Grote)

Distribution.—The writer has taken the adults of *Rhynchagrotis cupida* in light traps at Wichita, Kans., and Scottsbluff, Nebr. It has also been reported from Ohio.

Economic status.—This species is of no economic importance in the central Great Plains. It was reported doing damage to fruit buds in Ohio in 1925.

Scotogramma trifolii (Rottemburg)

Clover Cutworm

Distribution.—This species is recorded throughout the United States, Canada, Europe, and northern Asia.

Economic status.—In the Great Plains States it is of minor economic importance.

Food plants and larval habits.—The larvae are diurnal and are general feeders, but prefer beets and lambsquarters. On lambsquarters their coloration blends admirably with the grayish-green foliage. On sugar beets the larvae prefer the older foliage, and often strip the leaf to the petiole, leaving only the midrib. Small beet plants are stripped of their foliage, but unless the crown is eaten they usually recover. The writer has taken the larvae in small numbers in alfalfa.

Seasonal history.—Marsh (*13*) states that there are three generations of this species each year in the Arkansas Valley in Kansas, and that it passes the winter in the pupal stage in cells in the soil. During a severe dust storm near Garden City, Kans., on March 21, 1935, the writer found many exposed pupal cells along the edge of a field from which the top soil had been blown away. Many cells had been broken open, exposing the pupae, most of which were dead. Pupae in unbroken cells lying on the soil surface were still living, and a number that were brought into the laboratory yielded adults during the first week in April.

Adults were collected at light traps throughout the season from March to November. At Garden City they were taken in greater numbers than any other species of Phalaenidae; nearly 87,000 specimens were recorded during the season of 1935 alone. Marsh (*13*) states that the adults deposit eggs during the latter half of May, and adults of this generation appear early in July. The larvae of the third generation mature late in the fall, go into the winter in the pupal stage, and produce adults the following spring. He also records that the larvae are most numerous on beets during the latter half of June. The writer found them most numerous on alfalfa and lambsquarters during September.

Natural enemies.—Of 148 larvae collected in the field, 12 percent were parasitized by Hymenoptera and 16 percent by Diptera and 22 percent died of disease. Parasites and disease organisms reared from the larvae were as follows:

Hymenoptera—*Apanteles plathypenae* Mues., *Eulimneria* sp.
Diptera—*Euphorocera* sp. near *tachinomoides* (Tns.), *Schizocerophaga* sp., *Zenillia hyphantriae* (Tns.), *Winthemia quadripustulata* (F.).
Disease organisms—*Beauveria* sp., unidentified wilt.

Ceramica picta (Harris)

Zebra Caterpillar

Distribution.—This species is found in the Atlantic Coast States and westward to Utah, as well as in the eastern Provinces of Canada.

Economic status.—This caterpillar is of no economic importance in the central Great Plains. Elsewhere, particularly in the eastern part of its range, it is an important pest.

Food plants and larval habits.—Although this species is a general feeder, it shows a preference for garden crops. The writer has taken the larvae on sweetclover. The larvae are diurnal, but do not conceal themselves as do most species of cutworms.

Seasonal history.—According to Chittenden (*2*, pp. 30–37) there are two generations annually. They pass the winter in the pupal stage. The first-generation moths appear in May and June, the second-generation moths late in August. At light traps adults were taken from early in April to early in October.

Natural enemies.—Of 10 larvae taken on sweetclover, 1 was parasitized by *Apanteles militaris* (Walsh), 1 developed the fungus *Metarrhizium anisopliae* (Metsch), and 1 died of an undetermined wilt.

Protoleucania albilinea (Hübner)

Wheat Head Armyworm

(Figs. 4, *O*; 5, *B*; 7, *J*)

Distribution.—This armyworm is widely distributed in Canada from Nova Scotia to Alberta, and in the United States from the Atlantic Coast States westward to Utah and Arizona. It is also found in South America.

Economic status.—In the central Great Plains the wheat head armyworm is of minor economic importance. In its eastern range it causes widespread damage at times.

Food plants and larval habits.—The species feeds almost exclusively on members of the grass family, being most destructive to wheat, oats, rye, and timothy. The larvae are diurnal, and their habit of feeding on the heads of wheat has given the species its common name.

Seasonal history.—Webster (*22*) states that there are two generations a year in Iowa. There the moths emerge in the spring and deposit the eggs, which hatch the last part of May. The larvae of the first generation become full-grown about July 1 and enter the soil to pupate, the adults appearing in August to produce the second generation. The larvae of the second generation mature late in the fall, pupate, and remain in the pupal stage through the winter.

In Kansas the larvae are most abundant in June. Adults were taken at lights from late in March to the middle of October, with two definite periods of heavy flight, one during the last 10 days of April and the other beginning late in August and continuing well into September.

Reproductive capacity.—One dissected female contained 1,057 eggs.

Natural enemies.—Of 156 larvae collected in the field, largely by net sweeping in ripening wheat, 5 percent were parasitized by Hymenoptera and 1 percent by Diptera and 7 percent developed disease. Parasites and the disease organism reared were as follows:

Hymenoptera—*Campoletis oxylus* (Cress.), *Rogas atricornis* Cress.
Diptera—*Phorocera claripennis* (Macq.).
Disease organism—*Metarrhizium anisopliae* (Metsch).

Leucania phragmatidicola Guenée

(Figs. 4, *Y*; 7, *Q*)

Distribution.—This species occurs throughout the United States east of the Rocky Mountains and in California.

Economic status.—It is of no economic importance in the central Great Plains.

Food plants.—The larvae feed on various grasses including bluegrass and wild-rye, and are most commonly found in grassy alfalfa fields, in pasture lands, and along grassy roadsides.

Seasonal history.—There are two generations annually. These armyworms overwinter as partly grown larvae, and are full-grown by the last of March. They pupate in April and May, and the adults appear late in May and early in June. No larvae were taken during the summer, but adults again appeared in numbers in September. In some years light-trap collections showed the adults to be present from late in April to the middle of October, with two periods of pronounced abundance, one early in June and the other early in September.

Natural enemies.—Of 40 larvae collected in the field, only 1 developed disease; none were parasitized.

Cirphis unipuncta (Haworth)

Armyworm

(Figs. 4, *X*; 7, *P*)

Distribution.—The armyworm is found throughout the United States east of the Rocky Mountains and in Canada. It is also recorded from Utah, California, and northern Mexico.

History and economic status.—This species is of major economic importance, being one of the most destructive of the Phalaenidae. The larvae periodically appear in hordes and, assuming the army habit, do widespread damage to crops, particularly the cereals. The armyworm has been known to be a serious pest of cereal and forage crops since early colonial times. In 1632 Peter Kahn, a Swedish naturalist traveling in this country, recorded it as injuring corn[6] in New England. In 1743 there was a great outbreak in what is now the North Atlantic States. There have been other outbreaks at irregular intervals, one of the most severe on record being in 1861. In 1914 the entire region east of the Rocky Mountains was injured. Extensive outbreaks were also noted in 1937, 1938, and 1939.

Food plants and larval habits.—The armyworm prefers grasses, but feeds on a wide variety of plants. When the larvae assume the army habit, they feed during the day, although normally they remain hidden at that time. The larvae frequently feed on the heads of ripening wheat, gnawing into the spikelets containing the forming seed, eating the awns, and often severing the head at its junction with the stem. In one instance a field of Kanred wheat, a bearded variety, had been injured so severely that from a distance it appeared to be a beardless variety. Of 1,000 straws examined, none of the

[6] In colonial times wheat was referred to as corn, and the term "maize" was applied to corn.

heads had escaped injury, over half had been partially destroyed, and the rest had been severed from the stems.

Seasonal history.—There are normally three generations of this species annually in the central Great Plains. The armyworms pass the winter as partly grown larvae or in the pupal stage. In mild winters the hibernating larvae probably carry the species through the winter. Adults begin to emerge early in the spring and are present in varying numbers from early in March to late in November. The larvae are most abundant during May and June, but at times are numerous in September, especially in millet. The summer generation has never been observed in important numbers. The eggs are laid in the leaf sheaths of various grasses, where, upon hatching, the larvae feed, moving only in search of food. The adults are strong flyers.

Natural enemies.—Generally the larvae of this species are heavily parasitized, particularly those of the spring generation. Larvae were collected from 1922 to 1940. From those reared the mortality from various natural enemies was determined, with results summarized in table 5.

TABLE 5.—*Mortalities of larvae of Cirphis unipuncta caused by various natural enemies, 1922–40*

Year	Larvae observed	Larvae killed by—			Total mortality
		Hymenoptera	Diptera	Disease	
	Number	*Percent*	*Percent*	*Percent*	*Percent*
1922	1	100	0	0	100
1923–26 [1]					
1927	86	13	4	0	17
1928	1	0	0	0	0
1929–32 [1]					
1933	152	2	14	0	16
1934	123	4	.8	0	5
1935	243	26	1	4	31
1936 [1]					
1937	203	46	0	2	48
1938	127	67	5	3	75
1939 [1]					
1940	154	19	14	0	33

[1] No collections.

Parasites and disease organisms reared were as follows:

Hymenoptera—*Apanteles militaris* (Walsh), *Netelia ocellata* (Vier.), *Rogas terminalis* (Cress.), *Catolaccus aeneoviridis* (Gir.), as a hyperparasite of *Apanteles militaris*.

Diptera—*Archytas basifulva* (Walk.), *Archytas apicifera* (Walk.), *Achaetoneura melalophae* Allen, *Euphorocera* sp. probably *tachinomoides* (Tns.), *Winthemia quadripustulata* (F.), *Wagneria* sp. probably *carbonaria* (Panz.).

Disease organisms—*Metarrhizium anisopliae* (Metsch), unidentified wilt.

Adita chionanthi (Abbott and Smith)

Distribution.—This species is found in the Atlantic Coast States and westward to Kansas, Nebraska, Colorado, and Wyoming.

Economic status.—It is of no economic importance.

Food plants.—Recorded food plants of this species are *Chionanthus* (fringetree) and *Triosteum perfoliatum* L. (tinker's weed, wild coffee). The writer took one larva in pasture land, where the predominant grass was little barley.

Seasonal history.—Light-trap records indicate that there is but one generation a year, the moths appearing in September. This species probably passes the winter as a partly grown larva. One larva was collected on May 24 and pupated on June 1. The adult emerged on September 16. Thus the summer apparently is passed in the pupal stage.

Rusina (formerly Parastichtis) bicolorago (Guenée)

Distribution.—This species is rather widely distributed, being recorded from Canada, Maine, New York, Pennsylvania, Virginia, Tennessee, Iowa, and Texas. The writer has taken the species in Kansas and Nebraska.

Economic status.—It is of minor importance in the central Great Plains, but sometimes becomes numerous locally.

Food plants.—The larvae feed on tobacco, *Rumex crispus* L., soft maple (*Acer saccharinum* L.), and cabbage. The writer found the larvae most numerous in and about clumps of mushrooms, on which they fed readily in captivity. The soft brown shades of the larvae blend well with the colors in mushrooms.

Seasonal history.—There is but one generation of this species a year. The moths appear late in the season, usually not until the end of October. *Rusina bicolorago* was one of the last species to be taken at light traps in the latitude of Manhattan, Kans. Crumb (*5*) records that in Tennessee it probably passes the winter in the egg stage, the eggs hatching early in the following spring. The larvae reach maturity late in April and form tough cocoons of silk mixed with soil. They pass the summer as inactive larvae, pupating late in August and September.

Prodenia ornithogalli Guenée

Yellow-striped Armyworm

(Figs. 4, *Q*; 6, *A*; 7, K)

Distribution.—The yellow-striped armyworm is widely distributed in the United States, but is most common in the South. It is found also in the Bahama Islands, Puerto Rico, and Mexico.

Economic status.—In the central Great Plains the species is of minor economic importance, at times becoming numerous locally. In the South it is of considerable importance as a pest of cotton and of various vegetable crops.

Food plants and larval habits.—The species is a general feeder. In their early stages the larvae are frequently diurnal, but in their later stages they hide during the day in trash on the surface of the soil. As

a rule the larvae are solitary, probably because, on hatching, they are capable of spinning down on silken threads and are thus dispersed by the wind.

Seasonal history.—There are three to four generations a year. In the central Great Plains the winter is passed in the pupal stage. Adults were captured at light traps from late in March to the end of October, the flight being heaviest in July and August. This species is difficult to rear in captivity, owing to the prevalence of a disease that kills the larvae quickly. Observations indicate, however, that the spring generation produces adults in July and August. The summer generation develops rapidly, and adults from this generation appear in September. These adults give rise to the third generation that includes overwintering pupae. The eggs are deposited in masses, which are covered with scales from the female's body. They were most frequently found on the under side of leaves.

Life cycle.—Spring generation: This generation was not reared in this work.

Summer generation: The summer generation develops rapidly, 23 to 25 days having been required from egg to adult in one reared series.

Fall generation: Eggs deposited on September 18 hatched in 3 days. The larvae pupated from October 22 to 25 and passed the winter in that stage. Adults began emerging on March 27 and continued to April 11.

Reproductive capacity.—Two dissected females contained 2,189 and 1,622 eggs.

Natural enemies.—Of 72 larvae reared, 6 percent were parasitized by Hymenoptera and 7 percent by Diptera and 17 percent were killed by an unidentified wilt disease. The following parasites were reared:

Hymenoptera—*Euplectrus comstocki* How., *Chelonus texanus* Cress.
Diptera—*Winthemia quadripustulata* (F.).

Laphygma exigua (Hübner)

Beet Armyworm

(Fig. 4, *P*)

Distribution.—The beet armyworm is distributed throughout the Gulf States and westward to the Pacific coast. It is also recorded from Kansas and Nebraska.

Economic status.—This species is of minor economic importance in the central Great Plains.

Food plants and larval habits.—The beet armyworm is a general feeder. In Kansas the larvae are minor pests of sugar beets, but at times are abundant in alfalfa. They are diurnal, feeding actively during the day. Their greyish green blends with the green of the host plants, so that the larvae are difficult to see when resting on a stem.

Seasonal history.—There are probably two generations a year of this species in Kansas. Adults were taken at lights from early in May to late in October and were most numerous in July and August. Presumably they pass the winter in the pupal stage.

Natural enemies.—Of 120 reared larvae, all collected from alfalfa, 18 percent were parasitized by Hymenoptera and 0.8 percent by

Diptera and 20 percent died of disease. The following parasites and disease organisms were reared:

Hymenoptera—*Netelia ocellata* (Vier.), *Chelonus texanus* Cress., *Pristomerus* (*Neopristomerus*) *appalachianus* Vier.
Diptera—*Euphorocera tachinomoides* (Tns.).
Disease organisms—*Beauveria* sp., *Isaria* sp., *Botrytis* sp., unidentified wilt.

Heliothis armigera (Hübner)

Corn Earworm

(Figs. 2, *G*; 4, *J*)

Distribution.—The corn earworm is distributed throughout the United States.

Economic status.—It is of major economic importance in the central Great Plains and eastward and southward of that region. It is perhaps the most continuously destructive species of Phalaenidae found in the United States.

Food plants and larval habits.—In the central Great Plains this species is primarily a pest of corn and grain sorghums, but at times extends its feeding to alfalfa, particularly in September when other favored food plants are not available. In one instance it destroyed approximately 2,000 acres of fall-sown wheat near Stockton, Kans. This is believed to be the first record in the United States of winter wheat being injured by this species. The outbreak occurred in September in wheat planted in old wheat stubble, and damage was most severe in weedy areas, where the predominating growth was pigweed (*Amaranthus* sp.). Evidently at oviposition time the adults had been attracted to the weeds, probably because they were the only green plants available at the time. The larvae defoliated the weeds and were forced to the wheat. It was apparent that the young wheat plants were unpalatable and unsatisfactory as a food, because the larvae did not consume the plants, but either mutilated the leaves or cut off the plants at the soil surface, where they were left uneaten. The larvae were much smaller than normal, and moths reared from them had only about half the typical wing spread.

Seasonal history.—There are three generations of this species a year in the central Great Plains. Normally it passes the winter in the pupal stage, although Blanchard (*1*) reports the winter mortality to be heavy. In severe winters the species probably is almost eradicated from the region, and reinfestation is due mostly, if not entirely, to migration of moths from more southern latitudes.

Natural enemies.—Of 159 larvae collected from alfalfa during September and October, 38 percent were parasitized by Hymenoptera and 1 percent died of disease. The parasites and disease organism reared were as follows:

Hymenoptera—*Microplitis croceipes* (Cress.), *Campoletis perdistinctus* (Vier.)
Disease organism—*Beauveria* sp.

Heliothis phloxiphaga Grote and Robinson

Distribution.—This species is recorded as being widely distributed in the United States.

Economic status.—It is of no economic importance in the central Great Plains.

Food plants.—Calendula, Phlox, and gumplant (*Grindelia squarrosa* (Pursh) Dunal) are its common host plants.

Seasonal history.—Two larvae of this species were taken on *Calendula*. They were diurnal. This is probably a multiple-generation species, the moths being captured at lights from April to September.

Anagrapha falcifera (Kirby)

Celery Looper

Distribution.—This species is widely distributed in the United States.

Economic status.—It is of no economic importance in the central Great Plains.

Food plants and larval habits.—The writer has taken this species on sweetclover. The larvae are diurnal.

Trichoplusia ni (Hübner) (formerly Autographa brassicae (Riley))

Cabbage Looper

Distribution.—The cabbage looper is widely distributed in the United States and Canada.

Economic status.—This species is of no importance as a pest of cereal and forage crops in the central Great Plains, but it is destructive as a garden pest.

Food plants and larval habits.—The larvae are diurnal and are general feeders, but prefer cruciferous crops. The writer has taken the larvae on sweetclover.

Caenurgina erechtea (Cramer)

Forage Looper

(Fig. 4, *BB*)

Distribution.—The forage looper is widely distributed in Canada and in the United States as far west as Utah.

Economic status.—It is of minor economic importance throughout its range.

Food plants and larval habits.—The larvae are diurnal and are general feeders, although found most frequently in alfalfa and pasture lands.

Seasonal history.—Apparently there are three generations of this species a year. It passes the winter in the pupal stage, the adults emerging early in the spring. The fact that adults were taken at lights throughout the season indicates an overlapping of generations in common with most of the multiple-brooded species. The larvae are most abundant in the fall. They make flimsy cocoons of silk and leaves in which they pupate on the surface of the soil.

Natural enemies.—Of 29 larvae reared, 14 percent were parasitized by unidentified Hymenoptera.

Tathorhynchus angustiorata (Grote)

Distribution.—The writer has taken *Tathorhynchus angustiorata* in Kansas and Nebraska. It is also recorded from Colorado.

Economic status.—It is of little economic importance.

Food plants and larval habits.—The larvae were captured on alfalfa, in association with the forage looper (*Caenurgina erechtea*), and at times were more abundant than the looper. The larvae are diurnal and superficially resemble those of *C. erechtea.*

Seasonal history.—The seasonal history of this species is similar to that of the forage looper.

Natural enemies.—Of 72 larvae reared from field-collected material, 3 percent were parasitized by Hymenoptera and 28 percent died of disease caused by 3 species of fungus—*Beauveria* sp., *Isaria* sp., and *Metarrhizium anisopliae* (Metsch).

Plathypena scabra (Fabricius)

Green Cloverworm

(Fig. 4, *AA*)

Distribution.—The green cloverworm is distributed throughout the United States and southern Canada east of the Rocky Mountains.

Economic status.—It is of minor importance in the central Great Plains. Occasionally there are widespread outbreaks east of the central Great Plains.

Food plants and larval habits.—The larvae feed on a wide range of plants, but show a preference for legumes. In the central Great Plains they are abundant in alfalfa at times, particularly in September. The larvae are diurnal, are very active, and at the slightest disturbance fall to the ground. When touched, they wriggle about with amazing speed. When at rest, their green color blends perfectly with the green of alfalfa.

Seasonal history.—Hill (*9*) reports that the green cloverworm hibernates in both the larval and pupal stages, and passes through four generations a year at Nashville, Tenn. The adults were taken at lights from late in June to late in October.

Natural enemies.—Of 56 field-collected larvae, 7 percent developed disease.

BORING CUTWORMS

This group of cutworms has developed the habit of boring into the stems or crowns of their host plants. Only two species of this type were found infesting cereal and forage crops in the central Great Plains.

Crymodes burgessi (Morrison)

Distribution.—This species is recorded from Massachusetts, New York, Arizona, and Nebraska. The writer has taken both adults and larvae in Kansas.

Economic status.—This species is of no economic importance.

Food plants and larval habits.—Only two larvae were taken in this investigation. They were boring in the crowns of an undetermined

bunchgrass, probably *Andropogon* sp. In captivity they bored into the crowns of bluegrass.

Seasonal history.—There is but one generation of this species a year. It evidently passes the winter as a partly grown larva. Larvae taken on April 3 appeared to be nearly mature, but continued feeding until the last of June. After constructing pupal cells within their tunnels in the crowns of the host grass, they remained inactive until they pupated late in August. Adults emerged in September. Adults were taken at light traps in September and the first half of October.

Papaipema nebris (Guenée)

Stalk Borer

(Figs. 4, *R*; 6, *B*; 7, *L*)

Distribution.—The stalk borer is widely distributed in the United States east of the Rocky Mountains. It has been reported from southern Canada to the Gulf of Mexico.

Economic status.—It is of minor economic importance in the central Great Plains, occasionally becoming abundant locally.

Food plants and larval habits.—This species feeds on a wide variety of plants, 176 host plants having been recorded. In their younger stages the larvae bore into the stems of plants, showing a preference for bluegrass, timothy, and orchard grass. They soon outgrow the small stems of these grasses and migrate to a new host to complete their development, provided the stem is large enough to accomodate them. If not, they migrate to still another host. In their later stages the larvae prefer the giant ragweed (*Ambrosia trifida* L.).

Seasonal history.—There is but a single generation of this species a year. The eggs are deposited in the fall in dead grass and hatch in the spring. The larvae become full-grown early in August, and usually pupate within the tunnel made by the larva. Adults emerge during September and deposit eggs.

Reproductive capacity.—When 16 reared females were dissected, they contained 1,324 to 2,560 eggs, averaging 1,987.

Natural enemies.—A total of 267 larvae, taken mostly from the stalks of giant ragweed, were reared individually. Of this number, 0.4 percent were parasitized by Hymenoptera and 6 percent by Diptera. The parasites reared from these larvae were as follows:

Hymenoptera—*Apanteles papaipemae* Mues.
Diptera—*Achaetoneura melalophae* Allen, *Lydella nigripes* Tns., *Sarcophaga* sp. near *cimbicis* Tns., and *Megaselia* sp. near *aletiae* were reared from puparia found in tunnels made by the larvae of *Papaipema nebris*.

CONTROL

Natural Control

Parasites, predators, disease, and climate are important factors in limiting cutworm and armyworm populations. Because of their tremendous reproductive capacity most of the species are able, under favorable conditions, to build up large populations quickly. No satisfactory method of evaluating the effectiveness of various

predators was devised. Without doubt, however, birds and predaceous beetles consume a great many cutworm larvae. A farmer in western Kansas reported that migrating hawks, descending on a field infested with pale western cutworms, practically eliminated them within a few hours. During outbreaks of the army cutworm large flocks of crows were seen in infested fields. Two crows were shot, and an examination of the stomach contents showed many fragments of army cutworm larvae.

Predaceous beetles consume large numbers of cutworms and armyworms, but no quantitative field records have been made. However, one specimen of *Calosoma lugubre* Lec. in captivity, offered full-grown larvae of the corn earworm, consumed 16 before indicating a loss of interest. The records of parasitism and disease given in this circular show that most species of cutworms and armyworms are subject to attack by natural enemies. Even larvae of subterranean habit do not escape. Instances were observed where outbreaks of both surface and subterranean forms were brought under control by a devastating disease, which rapidly reduced the larval populations.

Chemical Control

With the exception of the subterranean and boring groups, which are controllable only by cultural methods, most species of cutworms and armyworms can be checked with poison bait. The recommended formula for poison bran bait is as follows:

Bran	100 pounds.
Paris green, white arsenic, or sodium fluosilicate	4 pounds.
Water	10 to 12 gallons.

The finished bait should crumble easily when compressed in the hand. In infested areas the bait is broadcast evenly at the rate of about 15 pounds (dry weight) per acre.

CAUTION.—The poisons used in baits for cutworms and armyworms are also poisonous to animals and man. Keep children, poultry, pets, or livestock from gaining access to the poison or to the receptacles containing the poisoned bait or used in mixing it. Clean thoroughly all utensils immediately after being used. Broadcast any surplus bait thinly on the ground in a field.

If the larvae are almost mature, results from the use of poison bait may be disappointing. It is therefore important to determine whether the larvae are still actively feeding when the bait is distributed. In many cutworm infestations the damage is frequently done before control measures can be applied. This is largely because the larvae consume most of their food during the last two larval instars and the feeding by the earlier instars is not noticeable. For this reason growers should maintain a close watch in order to detect large populations of young larvae and apply control measures before damage becomes serious.

Cultural Control

In the central Great Plains, where there are outbreaks of the pale western cutworm, the author (*20*) found that the damage to wheat could be minimized by the use of summer fallow. This method of control consists of alternating wheat culture and summer fallow.

The stubble after 1 year's crop is left undisturbed until the following spring, when the ground is cultivated and kept clean throughout the summer until wheat-seeding time. The spring cultivation should start as early as possible without incurring danger of spring soil blowing, preferably before April 15. Wheat on summer-fallow ground in which insufficient moisture was stored while fallow, or which supported any weed growth during the egg-laying period of the moths, was subject to attack during periods of heavy general infestation.

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